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# JPRS Report

# Science & Technology

## Europe

# Science & Technology Europe

*JPRS-EST-89-011* *10 APRIL 1989*

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# ADVANCED MATERIALS

## EC Council Announces BRITE/EURAM Aeronautics R&D

*AN890091 Luxembourg OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES in English No C33, 9 Feb 89 p 5*

[Announcement: "Advance Notice—BRITE/EURAM (1989 to 1992)—Specific Activities Related to Aeronautics"]

[Text] A.

The Council of Ministers has adopted on 15 December 1988 a common position on BRITE/EURAM [Basic Research in Industrial Technologies for Europe/ European Program on Advanced Materials] including the following five areas of activities:

1. Advanced materials technologies.
2. Design methodology and assurance for products and processes.
3. Application of manufacturing technologies.
4. Technologies for manufacturing processes.
5. Specific activities relating to aeronautics.

Council approval of this programme is expected during the first quarter of 1989.

B.

Areas 1 to 4 are presently the subject of a call for proposals having a closing date of 12 May 1989.

C.

Area 5 covers precompetitive research in technological areas which are of primary relevance to aeronautics—both fixed wing and rotating wing aircraft—and which are not yet covered in other programme areas, in particular:

**5.1. Aerodynamics**

5.1.1. Analysis and optimization of configurations for supersonic aircraft, including an estimation of aerothermodynamic heat loads.
5.1.2. Investigation of laminar flow technology.
5.1.3. Development of numerical methods.
5.1.4. Integration of computerized design technologies.

**5.2. Acoustics**

5.2.1. Noise source identification, prediction and reduction.
5.2.2. Basic investigation of acoustic fatigue and related damage tolerance of advanced composites.
5.2.3. Investigation of different construction methods.
5.2.4. Development and application of stimulation models for response calculations under selected acoustic loads.

**5.3. Airborne Systems and Equipment**

5.3.1. Integration and operation of modern systems and equipment and corresponding new architectures.
5.3.2. Investigations concerning the use of onboard intelligent knowledge-based systems (IKBS).
5.3.3. Investigations into the concept of the "all-electric aircraft."

**5.4. Propulsion Systems**

5.4.1. Integration of advanced propellers and propeller-rotor systems.
5.4.2. Provision of mathematical models for different design evaluation.
5.4.3. Specification and design of wind tunnel models and their components.
5.4.4. Specific aspects of air-breathing engine combustion.

The objectives of area 5 will be further defined in a detailed work programme and will be implemented during the first two years of the BRITE/EURAM programme through cost-shared contracts, of which the Community will pay up to 50 percent of the total cost.

While the objective of this part of the programme is to strengthen the technological competitiveness of the European aeronautical industry through increased collaboration, particular attention will be paid to a broad participation of research institutes, universities and industry, including small and medium-sized enterprises, and to maximize the benefit of such research to technological areas outside the aeronautics sector.

It is a purpose of this advance notice to invite those institutes, universities, and companies which consider participating in precompetitive industrial research covered by area 5 to register their interests. Any response to this invitation should contain the following information:

1.Type of organization (industry, industrial research institute, university).

2.Short description of the activities of interest and type of contribution by the organization, referring to the different topics of Paragraph C.

3. Relevant competence and experience together with the staff and facilities available.

## AEROSPACE, CIVIL AVIATION

### EC Council Issues Decision on ECLAIR Program

*AN890093 Luxembourg OFFICIAL JOURNAL OF THE EUROPEAN COMMUNITIES in English No L60, 3 Mar 89 pp 48-54*

[EC legislation: "EC Council Decision of 23 February 1989 on a First Multiannual Program (1988-1993) for Biotechnology-Based Agro-Industrial Research and Technology Development—ECLAIR (European Collaborative Linkage of Agriculture and Industry through Research)"]

[Text] The Council of the European Communities,

Having regard to the Treaty establishing the European Economic Community, and in particular to Article 130 Q thereof,

Having regard to the proposal from the Commission,

In cooperation with the European Parliament,

Having regard to the opinion of the Economic and Social Committee,

Whereas Article 130 K of the Treaty stipulates that the Framework Program shall be implemented through specific programs developed within each of its activities;

Whereas, by its Decision 87/516/Euratom/EEC, the Council adopted a Framework Program of Community Research and Technological Development (1987 to 1991), providing for activities to be implemented to ensure, among other things, the exploitation and optimum use of biological resources;

Whereas the said Decision stipulates that a specific objective of Community research must be to strengthen the scientific and technological basis of European industry, particularly in strategic sectors of advanced technology, and to encourage industry by making it more competitive at international level; whereas that Decision also lays down that Community action is justified if it contributes, among other things, to enhancing the Community's economic and social cohesion and to encouraging its overall harmonious development, while at the same time being consistent with the pursuit of scientific and technical excellence; whereas the ECLAIR [European Collaborative Linkage of Agriculture and Industry through Research] program, which is the subject of this Decision, is planned to contribute to the pursuit of these objectives;

Whereas the specialized skills and capabilities relevant to agro-industrial development are numerous, and Europe's most internationally competitive capabilities are located in diverse member states, mutual benefit shall be derived from collaboration in a Community program;

Whereas the activities undertaken in the program need to be accompanied by ongoing analysis of their associated costs and benefits to avoid their giving rise to new industries, which can only survive on the basis of permanently subsidized sales of agricultural products, or to agricultural surpluses;

Whereas such activities should constitute a logical complement to the Community research programs in the areas of biotechnology and agriculture, promoting the application of their results to the social and economic objectives of the Community.

Whereas the European Parliament has called for a study to be conducted into the structural and social consequences of promoting biotechnologies and genetic engineering and has also pointed to the risks associated with the use, especially the release, of genetically engineered organisms; whereas the revised Community biotechnology research program adopted on 29 June 1988 is undertaking research into these risks;

Whereas development activities at the interfaces between agriculture and industry could contribute to the solution of some of the problems which agriculture is currently facing within the Community;

Whereas the principal and most urgent requirements that must be satisfied focus on the development of types of agricultural production suitable for industrial purposes, of transformation technologies and of industrial inputs in agriculture, such as pesticides or fertilizers less harmful to the environment;

Whereas it is important to avoid any adverse effects for small and medium-sized agricultural enterprises which may be caused by a concentration of agricultural structures and further specialization;

Whereas it is necessary to involve small and medium-sized agricultural and industrial enterprises to the maximum extent possible in this biotechnology-based agro-industrial technological development program;

Whereas the Scientific and Technical Research Committee (CREST) has expressed its opinion,

has adopted this decision:

Article 1

A research and development program in the field of biotechnology-based agro-industrial research and technology development is hereby adopted in the form set out in Annex I for a five-year period starting on 1 July 1988.

The program shall consist of work carried out as contract research and as coordination actions and by training-/mobility grants. Participants may be industrial and agricultural enterprises—individual enterprises, associations or cooperatives—research institutions, universities or combinations of them, established in the Community.

Article 2

1. In the case of projects carried out by shared-cost contracts, the Community contribution shall not normally exceed 50 percent of the total expenditure, the remainder to be provided by the partners, perdominantly from industrial or agricultural sources.

Alternatively, in respect of projects carried out by universities and research institutes, the Community may bear up to 100 percent of the additional expenditure involved.

2. The proposals for projects shall be submitted in reply to a call for proposals and involve, as a rule, the participation of at least two independent partners not established in the same member state. As a rule, research institutes and universities should participate in a group together with one or more industrial or agricultural organization(s). Research institutes which are funded principally or exclusively by industrial organizations shall be considered as industrial partners.

Article 3

The funds estimated as necessary for the execution of the program amount to ECU 80 million, including expenditure on a staff of 13.

Article 4

The Commission shall be responsible for implementing the program.

The Commission shall be assisted by a committee of an advisory nature, hereinafter referred to as "the Committee", composed of the representative of the Commission.

Article 5

1. The representative of the Commission shall submit to the Committee a draft of the measures to be taken. The Committee shall deliver its opinion on the draft within a time limit which the Chairman may lay down according to the urgency of the matter, if necessary by taking a vote.

2. The opinion shall be recorded in the minutes of the Committee; in addition, each member states shall have the right to have its position recorded in the minutes.

3. The Commission shall take the utmost account of the opinion delivered by the Committee. It shall inform the Committee of the manner in which its opinion has been taken into account.

Article 6

1. In the third year of the program's implementation, the Commission shall undertake a review of the program and shall report to the European Parliament and the Council on the results thereof, together, if necessary, with any proposals for modification of the content and funding, or for prolongation.

2. After the completion of the program, an evaluation of the results achieved shall be conducted by the Commission, which shall report to the European Parliament and the Council. The report shall be drawn up by independent experts.

3. The reports referred to in Paragraphs 1 and 2 shall be established having regard to the objectives set out in Annex II and in conformity with the provisions of Article 2 (2) of Decision 87/516/Euratom/EEC.

Article 7

This Decision is addressed to the Member States.

[signed C. Romero Herrera]

**ANNEX I**

*Program for the first multiannual program (1988 to 1993) for biotechnology-based agro-industrial research and technological development—ECLAIR [European Collaborative Linkage of Agriculture and Industry through Research]*

***Aims***

The objective of the program here proposed is to promote in Europe the useful application of recent developments in the life sciences and biotechnology. This shall be achieved by a program of precompetitive research and technical development projects and coordination activities, based on close collaboration between agriculture and industrial activities, and supported by training-/mobility grants. The program shall contribute in the medium and longer terms to enhancing Europe's competitiveness in the economic activities which will be based on these developments and to strengthening economic and social cohesion in the Community.

The program shall avoid adverse effects on public health and the environment and the creation of problems in respect of the protection and enhancement of nature.

The principal objectives of this program are set out below:

- research, adaptation and development of agricultural products destined for industrial use, as well as the research and promotion of new industrial techniques for processing and transforming agricultural raw

materials with a view to obtaining, under economically viable conditions, industrial products which meet the needs of the market;
- research and development of industrial inputs in agriculture, such as pesticides and fertilizers, and of eradication and disease control systems less harmful or better adapted to the environment; the reduction and elimination of by-products of processing by recovering resources and reducing waste.

*Content*

The program shall be pursued through the measures set out below:

**1. Evaluation trials and production of new species or organisms**

This sector shall consist of test trials at appropriate scale and under various conditions of novel or modified species or organisms (plants, livestock, others) in order to test performance, pest resistance, input requirements, and aspects relevant to suitability for industrial processing, animal nutrition and market acceptability of the organism, its constituents, and the products derived from them with special emphasis on the use of new biotechnological methods in the identification, characterization, selection, modification, propagation, cultivation or other aspects of developing and appraising the candidate organisms.

**2. Industrial products and services**

This sector shall consist of:

2.1. More precise and effective inputs to agriculture through research and development work, based on the use of life sciences and biotechnology, aiming at the creation of products and services for use in agriculture, offering advantages in terms of precision, cost-effectiveness, enhanced plant or animal performance, suitability for subsequent product processing and/or marketing, and avoiding possible undesirable side effects;

2.2. More precise and effective extraction, transformation and production processes through research and development work on methods to increase the use and value of agricultural produce, by extraction, transformation or other processes, in industry or elsewhere, which by biotechnological or other means make greater or more valuable use of the intrinsic properties of these materials.

**3. Integrated approaches**

This sector shall consist of:

3.1. The improved utilization of the entire crop by the development, through trial systems, of systems for harvesting the whole crop, its preservation and splitting up into constituents appropriate for subsequent applications; such trial system(s) to be of adequate scale to provide a basis for economic appraisals and the significant participation of industrial and agricultural interests. Priority will be given to projects using new biotechnology;

3.2. Studies and development projects for the integrated use of new technologies which shall focus on the joint exploitation of progress in biological knowledge and techniques in conjunction with new-technology-based agricultural systems.

***Implementation***

Implementation of the projects shall be through cost-shared research and development actions and coordination activities. Training/mobility grants shall be included to facilitate the assembly of relevant skills at appropriate locations for the work of the projects and to promote effective diffusion of the knowledge resulting from them. The program shall also include the organization of meetings, consultation of experts, studies on related topics, and diffusion of information on the progress and results of the projects to all appropriate groups.

Each proposal shall include an environmental impact statement, indicating the possible effects of the project on man, fauna, flora, soils, water, air and on the interactions between these different factors. This statement must also include an undertaking to respect existing national safety regulations.

The contracts entered into by the Commission shall regulate the rights and obligations of each party, including the methods of disseminating, protecting and exploiting research results.

**ANNEX II**

*Evaluation criteria for the first multiannual program (1988 to 1993) for biotechnology-based agro-industrial research and technological development—ECLAIR*

The Commission's communication to the Council concerning a Community Plan of Action relating to the evaluation of Community research and development activities for the years 1987 to 1991 states that the objectives and milestones of each research program have to be set out in a testable form. The objectives and milestones of the above program are set out below.

1. The long-term objective of this program is described in Annex I.

2. The primary short-term objective is that the program should succeed in eliciting proposals, with commitments to co-finance from industry and/or agriculture, for development projects on a scale commensurate with the Community resources proposed. This objective shall be testable in 1991 to 1992.

By this time, the program should also have demonstrated its promotion and encouragement of intersectoral collaboration across the member states.

3. The criteria for the evaluation of the objectives to be attained during the first three years of the program's implementation are:

3.1. That tests of new or modified species or organisms have been conducted, and have given grounds to expect that these organisms, or the processes used to produce or modify them, represent progress and could find applications;

3.2. That tests have been conducted of new or modified products, techniques or services for use in agriculture; that advantages in terms of precision, effectiveness, or the avoidance of possible adverse side effects have been indicated; and that, as a result of the tests, the products, techniques or services have practical applications;

3.3. That tests been conducted of more precise and effective extraction, transformation and production processes, applying biotechnological and/or other methods to an agricultural output; and that, as a result of the tests, the processes are useful;

3.4. That, through the program, arrangements have been organized between farming and industrial/processing interests and facilities or equipment created, modified or made available, to test on one or more crops the technical feasibility of harvesting and using the whole plant; and that corresponding measures of performance have been, or are in course of being, defined to provide a basis for further system improvements and a basis for decision on the replication and diffusion of similar larger scale activities;

3.5. That studies have been financed and completed, and development projects supported, involving the use in agriculture of new technologies (e.g. involving sophisticated detection/measurement/recording techniques, information processing, automation of equipment and facilities), in conjunction with the application of biotechnology; and that, as a result of such studies and projects, new applications have been found;

3.6. That studies have been carried out examining the sociostructural and ecological impact of promoting biotechnology and genetic technology in agriculture.

4. In addition, the program should ensure that the following general criteria are met:

4.1. That the potential increase in market opportunities, in the medium or long-term, as a result of the improvements or benefits demonstrated, is of a size to justify the Community expenditures committed, which imply an analysis of the costs and benefits of these activities and their possible applications;

4.2. Taking account of the final reports on the Biotechnology Action Program, which ends in December 1989, and of the Biomolecular Engineering Program (1982 to 1986), and of the evaluation report(s) on these programs, consideration should be given whether this program is in fact effectively promoting the transfer towards application of the results of the earlier biotechnology (or biomolecular engineering) research programs;

4.3. That the execution of the program has avoided harmful effects on public health and the environment and has not created problems with respect to the protection and enhancement of nature;

4.4. Taking account of the results of Community, national or private sector research activities in biotechnology, the Evaluation Panel shall consider whether the ECLAIR program has given adequate consideration to all the selection criteria set out in Annex III to Decision 87/516/Euratom/EEC, which includes that of contributing to the strengthening of the economic and social cohesion of the Community, while being consistent with the pursuit of scientific and technical quality.

## Wind Tunnel Testing of A330, A340 Continues

*AN890089 Paris LA LETTRE HEBDOMADAIRE DU GIFAS in English 9 Feb 89 p 1*

[Text] The models of the A330 and A340 are still being tunnel tested by the research divisions of Aerospatiale, British Aerospace, and MBB. Gradually, the aerodynamics engineers are making final tunings of details and general conception. Since the wing design was frozen in May 1988 (the A330 and A340 have the identical wing except for a few minor details dictated by the engines), testing has been going on to fine-tune such details as optimum position of engines (completed by tests executed under cooperation arrangements with the engine manufacturers, for determining optimum pod design), fairing shapes, adjustments to slats and flaps and the airfoil of wing tip components. All these points can be handled only after general design has been firmly established and exact full-scale models made.

Dimensions and shape of the tail units, which are the same for the A330 and A340, were finalized early this year. The tail units have a high-performance aerodynamic profile and dimensions similar to those of the tail units of the A300 and A310, although the wing of the A330/A340 is nearly 50 percent larger. By the end of 1988, the Airbus Industrie partners had already completed one-third of the wind tunnel test program on the A330/A340, representing over 1,000 days of testing. These tests involve a collection of models from 1:50 to 1:20 in scale. They will continue even after the maiden

flight of the A340, scheduled for the spring of 1991, to establish correlations between study computation and actual test flight, while opening the way to new developments.

## FRG: BMFT Subsidizes Study on European Aerospace Programs

*MI890149 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German 16 Jan 89 pp 5-6*

[Text] The FRG research ministry has commissioned the IABG [Industrial Installations Administration Company] to study the technological significance of the three major ESA programs for FRG industry. The FRG is contributing on average 30 percent of the costs of these programs, amounting to DM8.3 billion by the year 2000. The results of the study are now available. The division of labor and costs are set out for each of the three programs, as well as the industrial organization at the European level. The FRG share of the new technologies that will be developed in these programs, their transferability to future aerospace projects, and the spin-offs for other fields are discussed. A few examples are mentioned below.

The future Ariane 5 launcher, which is also designed for astronaut transport, sets high safety and reliability requirements. It is based on developments in lightweight construction and on cryogenic propulsion technology.

A key task for FRG industry is to develop a cooled high-temperature-resistant combustion chamber using composite materials for the high-performance HM60 rocket motor. The acquired know-how is important for building future rocket motors and also in part for combination motors (airbreathers). This know-how is also applied in propulsion technology in general, energy generation and recycling plants, reactor technology, high temperature processes, the production of semifinished goods using metallic materials, and in the chemical industry.

Experience gained in safety and reliability is not only useful for future space programs; industry in general will also be able to use this experience for other programs. Exchange of know-how among suppliers, primarily small and medium-sized ones, is very important for the Ariane 5 project.

For the first time in Europe, the development of the Hermes space shuttle has brought to the foreground work in hypersonic aerothermodynamics, construction systems for withstanding extreme reentry stress, lightweight construction, safety systems, avionics, and automatic flight control. Gaining the necessary experience in the aerothermodynamics and flight mechanics of hypersonic flight, reentry into the earth's atmosphere, designing the "hot" structure and the heat shield system, and the development of high performance fuel cells for energy supply, are all urgent, technologically demanding tasks. This is of crucial significance for aerospace itself. By involving a large number of small and medium-sized companies in tackling these tasks, important know-how is transferred in metrology, data processing, plant construction, and cooling and insulation technology. Structural components for high working temperatures are of interest in the vehicle construction sector and the chemical industry. Higher performance fuel cells are in great demand for applications in many kinds of mobile equipment because of their good performance to weight ratio. An important field of technology for Hermes is the development of life support systems, advanced by German industry for practical applications in immersion technology, offshore technology, and for use in hazardous environments.

Work on life support systems is also of central importance in the Columbus program for the development of space station components. This program makes high demands on systems engineering and the safety and reliability management of individual components as well as the overall system (Columbus is designed to have a 30-year working life). The results, procedures, and precision processes that have been developed are also being introduced in technically sensitive fields unrelated to space technology, where they lead to an improvement in the standard of quality.

Space technology is also a pacesetter in that it applies the results of research in automation and robotics, and this is certain to open a new dimension in technical and routine space flight operations. Branches of industry not related to space technology are also participating.

Generally speaking, small and medium-sized companies outside the space sector are already involved to a considerable extent in developments and supplies for specialized space technologies. The space sector primarily specializes in system management, integration, and development work for special tasks in space technology.

This study emphasizes the technological significance of the three major programs. It shows that the money spent on space technology—and the money is spent on the ground—stimulates the FRG's industry and economy in many ways.

Furthermore, space technology exercises a positive influence not only on the European integration process, but also on scientific and technological training potential, and creates new, highly qualified jobs.

## MBB, PRC Firm Establish Joint Venture

*MI890118 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German 21 Dec 88 p 17*

[Text] A joint German-Chinese company with future headquarters in Hamburg has recently been established to plan, organize, direct, and coordinate the MPC-75 aircraft project. The company, set up by the German

aerospace corporation Messerschmitt-Boelkow-Blohm GmbH (MBB) and the China National Aero-Technology Import and Export Corporation (Catic)—a company run by the PRC's aerospace ministry—will conduct the PRC's first technology transfer project for aviation. The MPC-75 aircraft, which is still on the drawing board, is a completely new development. It is an 80-100 seat passenger aircraft with a range of 2,800 km, and is thus slightly smaller than the Fokker. The participants in the joint venture plan to sell the aircraft worldwide. The development phase will last until 1990, and the maiden flight is scheduled for 1994. The current project development phase, in which MBB has an 80 percent share and the PRC company 20 percent, is primarily financed by MBB with DM5 million.

## France To Develop Intelligent Flight Control Systems

*AN890078 Toulouse LA LETTRE DU CNES in French 12 Dec 88 p 14*

[Unattributed article: "Artificial Intelligence at the Service of Satellites"]

[Text] Three French companies—Aerospatiale, Electronique Serge Dassault (ESD), and Framentec—have just agreed to collaborate in developing expert systems, based on artificial intelligence technology designed to ensure the most efficient management and operation of geostationary satellites without requiring the intervention or advice of highly qualified engineers.

This type of equipment would be particularly useful to countries that have bought a satellite but that do not have personnel capable of immediately detecting a crisis situation which might threaten the life of the satellite.

By storing in all memory the technical specifications of a satellite, thanks to the experience of the design engineers, it is possible to transfer this know-how to operating personnel in a comprehensive, rational, and easily accessible manner. This expert system makes it possible to simplify the operators' work and improve their response times in emergency situations requiring rapid decisions.

The goal of the agreement is to research, develop, and manufacture such a system, and subsequently to market and maintain it.

Engineers from the three companies will first develop ground-based expert systems, followed by airborne expert systems capable of communicating with the former. It is conceivable that eventually men will no longer be required in satellite control centers, assuming that the electronic linking systems work.

The artificial intelligence tools used to build the prototype, which will receive the support of the Ministry of Industry and Research and the National Center for Space Studies (CNES), will be the EMICAT expert-system generator (produced by ESD) and tools developed as part of the European Strategic Program for R&D in Information Technologies (ESPRIT) program, in which Aerospatiale and the Framentec R&D department have taken part.

## French Aeronautics Future Linked to European Unity

*35190087b Paris LE QUOTIDIEN DE PARIS in French 21-22 Jan 89 p 13*

[Article by Henri Tricot: "Aeronautics in the Year 2000 Will Depend on Europe"; first sentence is LE QUOTIDIEN DE PARIS subhead]

[Text] For Aerospatiale President Henri Martre, European unity will take front stage in the future of the aeronautics industry.

"Aeronautics is a trade that makes you dream," Aerospatiale President Henri Martre said following a recent lecture to a group of former political science students. If you are in this "madman's trade" and you want to keep your feet on the ground, you suffer from cold sweats and, at times, real anxiety. In any case, in the opinion of the president of Aerospatiale, for both economic and technological reasons, the future of aeronautics depends both on a European framework and joint ventures or mergers. He likes to point out that the competitive power of all the European aircraft companies combined is only 40 percent of the U.S. competition.

Government funding, primarily military, is therefore indispensable to relieve some of the strain of research and development efforts, which absorb approximately one-third of Aerospatiale's income. The proposed 1990 U.S. budget increases allocations for scientific and technological research by 20 percent to Fr90 billion and only confirms Henri Martre's opinion. In comparison, European efforts are paltry. EEC plans in this area call for only 6 billion ECU (Fr42.6 billion) over a 5-year period, or 8.5 billion a year, and most of this amount is earmarked for computer and telecommunications research. "Fortunately," Henri Martre takes comfort in saying, "the Americans waste more money than we do."

However, unlike Hubert Curien, whose plan is to separate civil and military research, Henri Martre believes that the two should be linked for technological reasons as well. In support of his argument, he cites the case of the Concorde, which was the first French aircraft to exceed twice the speed of sound and which subsequently proved a useful experience in combat aircraft projects. Similarly, he feels that the instrumentation on the A320 is more sophisticated than on the Mirage 2000 and that the Rafale should borrow a few "tricks" from it. Also, the experience gained in developing inertial guidance systems for submarines and fighter aircraft was later useful for civilian passenger aircraft.

With these facts in mind, it is easy to understand Henri Martre's vision of the future—a vision confirmed by recent decisions. Aeronautics must be European, and the only obstacle to joint efforts is the current absense of a joint defense policy. The reason is simple: Very few manufacturers can launch major programs alone. This is illustrated by the agreement between the helicopter divisions of Aerospatiale and the FRG's MBB [Messerschmitt Boelkow Blohm], even if it is to take the form of two separate companies "crowned" by a joint management. In the jet transport field, "all the room is taken by Airbus," a fact that does not bother the president of Aerospatiale, a major partner in the consortium. However, this may be a handicap for future programs. The same question could have been asked of the future 100-seat aircraft that Aerospatiale is studying in cooperation with Aeritalia and Spain's CASA [Spanish Aircraft Manufacturing Company], because MBB is collaborating on the Fokker aircraft, and British Aerospace has its own program with the BAe 146.

**Projects for the 21st Century**

The president of Aerospatiale shows the same caution even when it comes to projects for the 21st century. He emphasizes that we know more or less what is needed should we wish to replace the Concorde: an approximately 300-seat plane with more fuel-efficient, quieter engines than the current ones. Technically, this could be done in 10 years, given the financing.

The AGV [High-Speed Aircraft], a competitor of the infamous Orient Express project launched by President Reagan, is up against several obstacles, according to Henri Martre. It is technically feasible, even though the only word on the engines is "we know it must be possible." Obviously, this aircraft, like the Orient Express, must be able to cross the Pacific. However, the biggest problem is probably that the cost of the aircraft would necessarily affect the price of tickets, and number of customers willing to pay "five times the cost of a first-class ticket" to cross the ocean in 2 hours is likely to be quite small. The cost of developing such an aircraft is far beyond the resources of a single firm, and the ideal solution would be a joint European-U.S. or European-USSR project. Also, achieving time savings significantly greater than with a supersonic aircraft would require fairly healthy passengers able to withstand quite intense acceleration. Reintroducing his argument concerning the links between civil and military aircraft, the president of Aerospatiale says that, for this reason—although it is supposed to be civilian, initially at least—the U.S. project will in fact be military. It will probably be used for observation missions, because the observation satellite requires a much longer "reaction time" than an aircraft that can go and observe information and bring it back within 2 hours.

These lovely theories could still be destroyed by a reversal in trends. The current boom in the aeronautics industry is fueled by businesses' "hunger for aircraft," Henri Martre explains. As a result, delivery periods have become so long that he suspects companies of placing orders or taking options simply to "save their place" on the assembly lines, while reserving the option to cancel everything at the last moment. The president of Aerospatiale is convinced of at least one thing: Dreams and predictions must not be confused, and what may appear to be cowardice, is ultimately only resistance to a certain romanticism inherent in aeronautics.

## Role of Selenia Spazio in Italian Space Program

*36980116 Milan INDUSTRIA OGGI in Italian Oct 88 pp 58-63*

[Article by Anna Borioni and Massimo Pieri: "Italy in Orbit With Selenia Spazio]

[Excerpts] Italy too is laying the foundations for the industrial and commercial uses of space. Government plans and Selenia Spazio's involvement in the most important European programs attest vividly to Italian vitality in the sector.

**Italian Space Agency**

The last step needed to launch an organic Italian space activity was taken by Parliament when it enacted the law that instituted the ASI [Italian Space Agency] in May of this year. The purposes for which the ASI was created are stipulated in Art. 2 of the law, which states: "The ASI will be responsible for the preparation of scientific, technological and application programs, including those aimed at enhancing the capabilities and competitiveness of the Italian national space industry..." It is interesting to note that the juridical form chosen for the ASI is that of an "agency"—that is, an entity under public law that operates in accordance with procedures laid down by private law, under the oversight of the Ministry of Scientific Research. This enables it to operate with greater organizational efficiency and flexibility, and to contract and place procurement orders directly with private entities and experts in the sector. The new agency is to be responsible for the functions that until now have been carried out by the CNR [National Research Council], thus becoming the public structure that will manage the National Space Plan and that will represent Italian scientific and industrial interests in the ESA [European Space Agency] programs and other international space undertakings.

For the immediate future—indeed for 1988—the budget law appropriated 772 billion lire to the space "adventure," 392 billion of which are to be spent for ESA-sponsored programs, with the remaining 380 billion lire being allocated to activities specific to the National Space Plan. These are still modest sums compared to the investment levels attained by other European countries. But the evolutive dynamic that is characterizing the sector in Italy as well, with the coming into being of specific scientific and institutional initiatives, attests to

the existence of a meaningful effort in our country as well to avoid being left behind in the race to make industrial and commercial use of space.

**Role of Selenia Spazio**

Realizing the truth of all of this, and intuiting the industrial importance of the space sector, the IRI-STET [Institute for the Reconstruction of Industry-Turin Telephone Finance Company] group created Selenia Spazio toward the end of 1982.

Its purpose was to create a company capable of offering complete space telecommunications systems, consisting of "satellite plus earth station," on a turnkey basis. This objective was attained in the space of a few years—to the extent that Selenia Spazio can claim an industrial dimension today equal to that of the sector's leading firms, besides being "the sole Italian industry engaged exclusively in space activities involving any application whatever."

Within the IRI, Selenia Spazio reports to the RSE [Selenia Elsag Group]. This Group consists of seven firms, each specializing in a specific segment of the major-electronic-systems field, with the Selenia company—well-known for its activity in the military sector—acting as prime contractor.

Selenia Spazio's economic performance demonstrates not only the vitality of the sector, but also that of the company itself, which in 1987 had billings of over 200 billion lire and an order portfolio of 367 billion. In the space of 5 years, it has doubled its staffing, which as of today totals 1,087 persons employed in four establishments: Two in Rome, one at L'Aquila, and one at Catania.

In Rome, besides its head office, the company has its Satellite Integration Center, where it assembles and tests satellite systems and subsystems, and designs the relative cabling. The Center, which employs some 100 specialized technicians, is equipped with a large anechoic chamber for compatibility tests of space antenna systems.

The Aquila plant's principal activity concerns the production of onboard equipment and the industrialization and production of equipment for earth stations. In the research and development sector, Selenia Spazio, at this plant, is involved in advanced technologies relative to composite materials for the construction of satellite antennas, as well as to microwave integrated circuits for various space applications.

The Catania establishment is devoted to research and development of equipment for earth stations.

Presently, Selenia Spazio is engaged at different levels of responsibility in various important national and international programs relating to the use of space for telecommunications and direct-TV transmission, meteorological observation, and remote sensing.

**Space Telecommunications**

In the telecommunications field, the use of satellites plays a strategic role in the realization of ISDN's [Integrated Services Digital Network(s)].

The coding of information and its transmission in digital form are the prerequisites for the development of advanced [integrated] telecommunications systems—integrated in the sense that they permit simultaneous transmission of voice, television, computerized data, graphic data and facsimile over one and the same facility. This integration of techniques and services is the technological innovation that is basic to the realization of those global processes, to which all the principal industrialized countries are committed, aimed at the application of data-processing techniques to telecommunications networks. According to recent estimates made on the basis of current programs in several European countries to modernize their existing networks, the penetration of digital techniques is expected to attain, by 1995: 26 percent in Germany, 60 percent in Italy, 75 percent in England, and 90 percent in France.

Viewed from this standpoint, a vast array of opportunities lies ahead for the Italian space industry, and for Selenia Spazio in particular, to develop significant roles, cutting-edge technologies and important infrastructures, all of which are vital to the resolving of the country's growth problems.

**Italsat**

The most important and demanding space telecommunications program under the National Space Plan is that relative to the Italsat system. Its objective is the realization of a pre-operational via-satellite digital network that will then be integrated with the cable network. The term "pre-operational" is used in the sense that the program will be managed on an experimental basis by SIP [Italian State-Owned Telephone Company], pending availability of the operational satellite.

Responsibility for the realization of the complete system, involving the design and construction of both the satellite and the earth segment, has been awarded to Selenia Spazio as prime contractor, with contributions to be made by other Italian aerospace firms, such as Aeritalia, SNIA-BPD, Laben, etc, for the realization of various subsystems, while the definition of the telecommunications system has been developed by the Telespazio company of the IRI.

The cost of Italsat is estimated at around 600 billion lire, a sum that is justified by the substantial amount of research activity that must go into the realization of a telecommunications satellite of extremely advanced design that is to operate entirely on the basis of digital technologies. Italsat will be the first satellite equipped with onboard base-band switching functions, enabling it to operate as a full-fledged intelligent telephone central

office. Operationally, the system will use new frequency bands in the uppermost part of the spectrum, at frequencies of 20-30 GHz, where the availability of channels is greater, and will have a capacity of around 12,000 telephone circuits. These circuits will be integrated into the Italian network by means of six beams covering the entire national territory.

The program's missions (payloads) are three:

1. Digital Telephony at 20-30 GHz with multibeam coverage of the SSTDMA [Satellite-Switched Time-Division Multiple-Access] type, at a transmission speed of 147 Mbits/sec, permitting more flexible use of the network in particular situations, such as daily and seasonal traffic peaks, terrestrial network outages, disaster-related emergencies.

2. Subscriber Services at 20-30 GHz with global coverage for video conferencing, remote transmission of newspapers, high-speed connections between computers and in cases of emergency.

3. Propagation tests at 40-50 GHz with European coverage for gathering of propagation data to be used in the designing of future systems.

The Italsat earth segment consists of traffic terminal stations, the network that is to be interfaced with the present switching exchanges, and an Operations Control Center for the management of operations aboard the satellite and throughout the network, and for the monitoring and control of the stations.

Development is presently under way on the first earth station designed to provide high-speed services via satellite telephone facilities. It will comprise a paraboloidal antenna, a receiver and a transmitter. The antenna used for these stations will be the result of a collaboration between Selenia Spazio and the CSELT [Turin Telecommunications Study Center], the purpose of which is to obtain an antenna of new design and development of innovative technologies, such as the use of new materials for the reflector (carbon fibers) and the use of solid state components for very high frequencies.

Italsat's launch is targeted for 1990. Its operational life will exceed 5 years. Another important program under way is the ESA's Olympus, under which four missions are to be developed. One of these is Direct-TV Broadcasting, considered one of the space-activity sectors destined to experience the most growth over the next several years. The ESA has awarded to British Aerospace the prime contractorship, and to Selenia Spazio the responsibility for the production and integration of all the satellite's telecommunications systems. The satellite will provide two channels, one of which will be assigned to the RAI [Italian Broadcasting Corporation] and the other to the Eurovision member countries.

The new service will extend the service areas covered by television broadcasts, improve image quality, increase the number of available channels, and provide the test bench for the development of high-definition television.

With the start of direct-TV broadcasting in Italy, scheduled for 1989, ordinary television sets will be able to receive programs directly from space by way of a small terminal, without having to go via earth-based repeater stations. A single transmitter per television network will suffice to send the signals to the satellite, which, in turn, will radiate them, blanketing the entire Italian territory and bordering countries.

In Europe, in addition to Olympus, the German TV-SAT program is also under way. Its satellite has already been launched but is not yet operational owing to a mechanical malfunction. The trouble has also brought about a delay in the launching of its French twin, the TDF, which will be orbited next year, a few months before Olympus.

**Argo**

Another particularly interesting telecommunications application is provided for under the Argo program: An Italian civil-defense satellite-communications system to provide emergency audio and video links, independent of the terrestrial communications infrastructure, in zones hit by natural catastrophes. The initiative also provides for the development, at the same time, of a system for the gathering of environmental data. The planning of the project was done by Telespazio, of the IRI-STET group, for the Civil Defense Ministry, which awarded to Selenia Spazio the contract for the supplying of a network of some 120 earth stations.

The Argo system will utilize the SMS [Satellite Multi-Service] business-services transponder on the European Eutelsat ECS satellite.

The terrestrial network will consist of a central control station installed at the Fucino Space Center and connected with the National Center for Civil Defense in Rome via a highly reliable overland coaxial-cable-and-microwave digital link. It will also include 12 transportable stations mounted on all-terrain vehicles and designed for rapid deployment, and capable of operating on disaster-stricken sites to provide video, voice and facsimile links with the central station. And 110 small fixed stations for the gathering of seismographic, volcanological, and hydrogeological data will be equipped with a paraboloidal antenna 1.8 to 2.4 meters in diameter depending on the site, and powered by photovoltaic cells in the event of unavailability of ENEL [National Electric Power Company] network.

**Remote Sensing of Environmental Resources and Meteorology**

According to Andrea Pucci, managing director of Selenia Spazio, "The market for space-based remote sensing looms as one of the commercial trends of the near future and will permit this technology to attain in a very short time the maturity that other sectors have attained." One can hardly disagree with this projection, considering the growing demand that has been taking hold in Italy, and not only in Italy, over the past 10 years or more, for information on the state and evolution of the environment. In this regard, the conviction can be comfortably affirmed to be taking hold that a territory—particularly if it is characterized by the delicate ecological balances typical of the Italian one—becomes ungovernable when human intervention is not planned on the basis of a thorough and detailed knowledge of the environmental mechanisms that characterize it.

The basic concept of remote sensing is not new. The very etymology of the term fully clarifies it: It means the acquisition of information at a distance, by sensing the electromagnetic energy emitted or reflected by the object being observed.

In this sense, the human eye is the most sophisticated "instrument" suited to this end, but with obvious limitations and problems.

The technology, on the other hand, has overcome and resolved many of these problems: Sensors can be installed on any platform (planes, satellites, helicopters, etc), can provide images both in analog (photographic) and digital (on magnetic tape) forms, and plot the electromagnetic energy emitted or reflected throughout the spectral band. For some purposes, a problem can stem from the limited resolution of space-based images arriving via satellite. In practice, this resolution attains a maximum of 10-30 meters, although this limit is less an inherent technological one than a commercial one, stemming from the need to reach a given number of users in order to render the sending of a sound into space economically viable.

The first applications of satellite-based remote sensing that proved commercially viable were meteorological ones. For several years now, international agencies, equipped with a satellite network and data processing centers, have been operating meteorological services.

The European organization, called Eumetstat, operating via satellites of the Meteosat series designed and built under the aegis of the ESA, provides meteorological service to Europe, Africa and western Asia.

Post-1990 plans call for the launching of four additional Meteosat satellites that are to remain operational until 1996 and provide meteorological coverage of the entire hemisphere centered about the zero meridian.

Selenia Spazio has participated in the Meteosat program since the start of its pre-operational phase. Today, it is involved in the realization of the operational system, for which it furnishes three subsystems: The system of antennas, which, among other things, will be electronically aimed (for the first time in Europe), the data processing system, and the telemetering and remote control system.

Especially relevant, from the standpoint of the development of future operating systems, is the technological content of the satellite's onboard systems, which, for the first time, will use microwave sensors, thus resolving the problem of nighttime visibility and visibility in the presence of clouds. Such systems are of particular interest for earth observation.

In connection with this mission, Selenia Spazio has been awarded the contract for the study and realization of a new type of radar: The Microwave Altimeter Radar. Satellite-based radar altimetry is useful in the topographic surveying of ocean surfaces and the surfaces of ice masses (both oceanic and continental). With a suitable earth-based system for processing the raw radar data, the values of wind velocity at the ocean's surface, of wave heights, of tides, and of currents can be plotted.

Conceptually, the operation of the Radar Altimeter is simple: A radar pulse measures the distance between the satellite's orbit and the surface point on the vertical beneath the satellite.

The height of ocean waves and the reflectivity of the ocean surface or of the surface of ice masses are determined by measuring the slope of the returning radar echo pulse front. Radar altimetry can be used to analyze the configuration, movement and development of continental and oceanic ice masses.

The Radar Altimeter that is to be installed aboard the [remote-sensing satellite] ERS 1 will include the corrections relative to the water vapor present in the atmosphere. The original project, which goes back to a study made some years ago by the Space Division of Selenia, was taken up again by Selenia Spazio and developed. It will enable the distance between satellite and Earth to be measured within an accuracy of the order of half a meter.

Thus, the Radar Altimeter will be able to measure wave heights of between 1 and 20 meters, and more generally to furnish, with a high degree of precision, the surface configuration of emergent land masses, seas and ice caps.

The ERS program promises important results in terms of technological fallout, for the development of new specialized missions, the development of improved sensors, and the extending of applications of this segment of space technology to other activities.

Selenia Spazio's involvement in the field of remote sensing is now a fundamental part of the company's technological and commercial growth strategy, under which the company plans to pursue various lines of research and to continue participating in and developing missions that "respond to the needs of the international markets or to the specific needs of the Mediterranean regions."

When the topics directly and indirectly connected with space activity are examined, one gains the impression that the civil use of space, when directly linked to the growth problems of industrial enterprises, is destined to contribute definitively to the configuration of the world's future social and productive orders.

Certainly it offers substantial advantages, and perhaps unprecedented prospects for change, to all those countries intent upon a decisive technological leap in the near future with respect to vital sectors such as communications, transport, and land use.

As has often been the case in Italy, industry, ahead of all the other sectors, has already intuited the vast potentials at stake.

In this respect, the example being set by Selenia Spazio—a "young" but forward-leaning company intent on capturing a commanding position on the international scene—is an enlightening one.

[Boxed insert, p 60]: **National Space Plan**

Italy has been a member of the European Space Agency since its creation, and since 1979 has had a National Space Plan [PSN] of its own.

The Plan is based on 5-year planning cycles, with periodic updatings. Initially, its management was the responsibility of the CNR [National Research Council], which set up a specialized operating structure for the purpose. In May 1988, this responsibility was transferred to the newly created Italian Space Agency, which was placed under the oversight of the Ministry of Scientific Research.

Its operating plan covers a broad spectrum of activities that ranges from those connected with commercialization to those of scientific and technological research, in fields such as telecommunications, propulsion, advanced structures, and environmental observations.

The enterprises working for the Plan are: Aeritalia, Carlo Gavazzi Controls, Fiat Research Center, Centro Studi dei Sistemi [Systems Studies Center], CISE, Contraves, CSATA, ELSAG, FIAR, FIAT AVIO, Italspazio, Italtel, Laben, Microtecnica, Officine Galileo, SAE, Selenia Spazio, SMA, SNIA-BPD, Telespazio, and VDS. Its principal programs are:

**Italsat.** This program has as its objective the realization of a pre-operational telecommunications satellite, operating with totally digital technologies, to serve as a test bench for the operating solutions to be adopted in the near future. The launch of this satellite is targeted for mid-1990.

**Monomic.** The object of this program is to develop integrated electronic components using the gallium arsenide technology, for the realization of the 12-GHz receiving equipment to be used in direct-TV satellite broadcasting.

**IRIS [Italian Research Interim Stage].** The purpose of this program is to realize a booster stage for the launching of payloads weighing between 600 and 900 kilograms from the American Space Shuttle. The Iris's first flight will involve the orbiting of the LAGEOS-2 geodetic satellite.

**Tether.** The Tethered Satellite System program is being developed in cooperation with NASA and has as its object the realization of an integrated system incorporating three basic elements: The Deployer, the Satellite it holds in suspension, and the Tether, or connecting line between them, whose length may exceed 100 kilometers. This system is expected to permit the taking of scientific measurements and the carrying out of technological missions at a distance of up to 100 kilometers away from the Shuttle.

**SAX.** This program involves the design and realization of a satellite for X-ray astronomy to explore the universe in the radiation band between 2 and 200 KeV.

**Telerilevamento [Remote Sensing].** A joint Italo-German program for the realization of an X-band SAR [Synthetic-Aperture Radar] to be carried aboard the Shuttle in connection with the SIR-C multi-spectral-radar earth observation mission.

A program for the realization of new computer architectures optimized for the preprocessing of remote sensing data. The new system is based on the ELSAG company's EMMA-2 multiprocessor.

**Space Geodesy.** A joint program in cooperation with NASA, involving direct observation of Earth's motions and crustal deformations. Its objective is to develop modern space-based instruments to be used in measurement surveys aimed at obtaining a better understanding of the Mediterranean area's tectonic phenomena. The program calls for the use of laser techniques with geodetic satellites by way of fixed and mobile stations. The Laser Ranging station located in the vicinity of Matera has been operating in Italy since 1983. To be installed

also in the same vicinity is a radiotelescope designed and built by Italian industry and optimized for use with VLBI [Very-Long-Baseline Interferometry] techniques as applied to stellar radiointerferometry. Also under way in cooperation with NASA is the realization of the second geodetic satellite LAGEOS-2. And the PSN coordinates and finances the scientific research activities being conducted by means of satellites, space platforms, interplanetary probes, and stratospheric balloons.

## Italian Consortium to Develop Software for Columbus Program

*MI890140 Rome AIR PRESS in Italian*
*17 Jan 89 p 140*

[Text] "Archimede" is the name of a consortium established by CISET, Intecs, and Laben that will take part in the competition that ESA [European Space Agency] will introduce by the end of the year. Stefano Ciarrocca, managing director of Intecs, is the chairman of the new consortium, while Stefano Benso, formerly a director of the ESA's technical center, is responsible for the research team the three companies are assigning to the program. All of Archimede's activities will be coordinated by Aeritalia, which has signed a cooperation agreement with the consortium. Aeritalia, AIR PRESS recalls, is the Italian prime contractor for the Columbus program and will therefore handle 70 to 80 percent of all orders placed with Italian companies (totalling approximately 1 trillion lire). Archimede can rely on an industrial base of 1,500 employees and 175 billion lire in total sales; CISET is primarily active in all aspects of the air traffic control sector, Intecs is involved in advanced software, and Laben, in space electronics (onboard information processing systems, remote control, and telemetry). At present, software accounts for approximately 20 percent of the total value of any space system. The competition ESA is sponsoring will take place at the European level, anticipating the single European market scheduled for 1993. However, ESA is taking the "fair repayment" provision into account, based on the size of the contributions made by the individual member states to the agency. This is the framework within which the competitions for the various elements of the Columbus system will be held, as well as those for related programs such as the DRS [Data Relay Satellite]. In addition, the companies that have already been selected to design and develop the relevant systems and subsystems in the preparatory stage will have to participate in the competition for the actual contract. A case in point is Selenia Spazio, which hopes to be named the prime contractor for the DRS. In the preparatory stage, the company had been awarded the contract for the entire communications system for Columbus—between the various elements, including the DRS, and between the DRS and the earth, and with the Hermes shuttle [as published]. As MATRA's partner, it had been awarded the contract for the data processing system. Selenia Spazio has already subcontracted a number of software packages to national companies specializing in the appropriate sector, such as Sesa Italia of Rome, which is also competing for some of these projects on its own account.

## Aeritalia, Aerospatiale, Casa Studying New Commuter Aircraft

*MI890109 Rome AIR PRESS in Italian*
*7 Dec 88 pp 2321-2*

[Text] (AIR PRESS)—The primary European manufacturers of commuter aircraft—Aeritalia and Aerospatiale, partners in the ATR program, and the Spanish manufacturer CASA, which produces the C-212 and developed the CN-235 with the Indonesian company IPTN—have begun to collaborate on the development of a new aircraft in this category. This state-of-the-art aircraft has a larger capacity than the current "commuterliners." An Aeritalia press release announced the news on 7 December; the text of that release follows:

"Aeritalia (IRI-Finmeccanica Group), the French company Aerospatiale, and the Spanish company CASA have signed an agreement to complete a market study and the subsequent technical definition of a state-of-the-art commuter aircraft with an 80-100 seat capacity. As part of this study the three European manufacturers will evaluate various propulsion systems for possible use in this new aircraft." The press release concluded: "The initiative undertaken by these companies, which are already active in the commuter market (Aeritalia and Aerospatiale with the ATR-42 and the ATR-72, and CASA with the CN-235 and the C-212), demonstrates their common desire to meet new demands in this particular market sector by the middle of the next decade."

AIR PRESS reports that an 80-100 seat plane, as opposed to the 40-44 seats in the CN-235, the 46-50 of the ATR-42, and the 66-70 of the ATR-72, appears to be the most interesting worldwide development goal for commuter transport at present. Only a few modern vehicles with this capacity exist, and these are aircraft created for a different type of traffic—closer to the second than to the third level. To completely meet operational and economic requirements for the third level of traffic, projects must make greater use of progress in other areas of technology, from materials to production techniques, propulsion, avionics, and of course, aerodynamics.

A profound transformation has taken place recently in air transport, beginning in the seventies with the increase in fuel costs and deregulation in the United States. This led the major carriers to abandon short routes with modest traffic volume, particularly in the United States. These carriers operated aircraft inappropriate to the routes (B-727, 737, and DC-9 jet aircraft), thus favoring the development of commuter airlines operating with more profitable aircraft, almost exclusively turboprops. Afterwards, while the concept of liberalization was expanding beyond the U.S. border, the situation was changing on other fronts as well: the stabilization or even drop in fuel costs; various difficulties encountered by many third level aircraft—in many cases these difficulties were resolved by their entry in networks controlled

by the major carriers, which reentered this sector; and the evolution of commuter traffic itself following legislative changes, the development of traffic and congestion in airports and airways, etc.

The market opportunity that this situation offered to commercial aircraft manufacturers in the late seventies was taken by Aeritalia and Aerospatiale, AIR PRESS recalls, bringing about the birth of the firm GIE Avions de Transport Regional and the creation of the ATR-42. Currently this is the most successful aircraft in its category; there are 170 definite orders and 53 options. Five years after the development of the ATR-42, market developments led the same industrial group to decide to launch a larger aircraft. The ATR-72 was inaugurated on 27 October last year and will become part of the fleet next July. It is already largely settled on the international market, with 43 orders and just as many options, including an order for 30 from TAT—a record for this class of aircraft. In the meantime, Aerospatiale and Aeritalia began a study on continuing the "ATR family," by announcing the development of a 92-seat plane.

CASA's signing of the recently announced agreement adds an important partner to the Franco-Italian association, thanks to the qualification of Spanish industry (which as AIR PRESS recalls, is associated with the EFA program for the future European jet fighter, and is a member of the Airbus Industrie consortium in the civil sector) and its privileged position in various markets from Latin America to Asia. Founded in 1923 to furnish the Spanish air force with a nationally produced metallic structure aircraft, CASA has a long tradition of collaboration with Italian and French aerospace industries, AIR PRESS recalls. After World War II it expanded its international cooperation and diversified its business, even including the helicopter sector. At present, it produces honeycomb parts for the DC-10/KC-10, B-757 flaps, MD-80 and Canadair amphibian CL-215 components, and parts for the Falcon 100 wing and Mirage F1 fuselage. It has a 4.2 percent share in Airbus Industrie, for which it produces horizontal tailplanes and other parts for the A-300, 310, and the A-320; it handles the maintenance of F-15 and F-4 jet fighters in Spain, the Spanish air force's VTOL's (AV-8A Matador and the AV-8B Bravo), and the FA-18 Hornets of the Ejercito del Aire. In the helicopter sector it has produced parts for the Sikorsky S-70, assembled 81 MBB Bo-105's and 6 AS-332-B Super Pumas, and is associated with the Tornal program. Finally, CASA managed the installation of the Searchwater radars on the Spanish navy's SH-3D's. Its original products include the widely exported C-101 training aircraft, in addition to the C-212 and CN-235 commercial aircraft already mentioned.

## Marconi To Investigate Laser Satellite Links

*AN890075 Chichester EURO-TELECOM in English 13 Jan 89 p 6*

[Unattributed article: "Marconi Space Systems To Conduct Advanced Laser Systems Feasibility Study"]

[Text] Britain's Marconi Space Systems Company is to investigate the feasibility of using advanced laser systems as an alternative to microwave links for intersatellite communications. The study, contracted by MATRA ESPACE of France, represents an extension to the European Space Agency's SILEX program, for which Matra is a prime contractor, and will probe the use of laser technology as an additional package to the main SILEX baseline program. The Marconi team will be supported by Standard Telecommunications Laboratories and Marconi Defence Systems as sub-contractors. Space communications links will be essential in the future to maintain continuous contact with low-earth-orbiting spacecraft such as space station elements or earth observation satellites, to enable the transfer to the ground of large quantities (100 Mb/s and more) of data they generate. Laser communications offer significant advantages over conventional microwave links in size and mass of hardware, plus their virtually unlimited bandwidth and carrying capacity.

## European Aerospace Industries To Develop New Supersonic Aircraft

*3698M063 Rome FINMECCANICA NOTIZIE in Italian 30 Sep 88 pp 10-11*

[Text] According to a statement released at the International Aeronautic Exhibition held at Farnborough in the UK, the research divisions of Europe's leading space industries (France's Aerospatiale, Italy's Aeritalia, the UK's British Aerospace, Spain's Casa, the Netherlands' Fokker, and the FRG's Messerschmitt-Boelkow-Bloehm) have undertaken a feasibility study within the framework of the "Euromart" project. "Euromart" concerns a new civilian supersonic aircraft designed to replace the Concorde, which was developed some time ago by Aerospatiale and British Aerospace but whose market success fell short of expectations.

With NASA's [National Aeronautics and Space Administration] support, Boeing and McDonnell Douglas are also working on a project to develop a supersonic aircraft. The American companies' objective is a 300-passenger aircraft, capable of flying at Mach 3.2 (Mach is the speed of sound) with a 12,000 km range, which is sufficient for trans-Pacific flights.

The oil crisis of the 1970s was one of the problems that hindered the development of the Concorde program. Today, the fall in oil prices has removed this obstacle, as the cost of fuel currently accounts for a mere 13 percent of all airline operating expenses—one-third of what it was ten years ago. Obviously, the development of the Concorde's successor will take quite some time; it is estimated that the new aircraft will not be ready before the year 2010. In the meantime, we will see whether the passenger plane of the future will be based on the spaceplane concept, such as the U.S. Orient Express X-30 or the British Hotol (featuring jet engines that use external oxygen within the atmosphere and onboard supplies of compressed oxygen in the stratosphere), or will conform to less ambitious supersonic aircraft projects.

# BIOTECHNOLOGY

## Rhone-Puolenc Opens Biotechnology Center

*36980147a Paris EUROPEAN BIOTECHNOLOGY NEWSLETTER in English 13 Jan 89 p 3*

[Text] Profits of Rhone-Poulenc (France) have jumped 40 percent in 9 months, after deduction of payments to minority interests. Rhone-Poulenc has enjoyed a 24.4 percent increase in pharmaceutical activity since 1986. The group plans to allocate FF4000 million to R&D this year, which is 8-9 percent more than during 1988.

A Biotechnology Institute has just been inaugurated. It comprises 7500 m2 of laboratory space, plus 2500 m2 of pilot plant capacity, and will employ about 200 researchers. Several major programmes are under way. Genetic engineering is being used to produce recombinant human albumin in microorganisms (in a joint project with Merieux), TPA and other therapeutic molecules for pathologies related to ageing such as cardiovascular diseases, neuronal degeneration (anti-glutamate), and cancer. Other diseases of interest include AIDS, certain lethal infections (semi-synthetic antibiotics), schizophrenias, rheumatoid arthritis, malaria and intractable pain. Improving vitamin B-12 producing strains is being worked out.

A major challenge will be to develop novel screening techniques for new drugs, by the molecular characterization of biological targets, the development of in vitro models for ailments such as depression, chronical degenerative diseases or atherosclerosis.

Contact: Professor Lunel, General Manager, Institut des Biotechnologies, Rhone-Poulenc Sante, 13 quai Jules Guesde, 94403 Vitry-Sur-Seine, FRANCE. Tel: 33-1-45738511.

## German Research Association Supports New Research Projects

*MI890117 Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German 21 Dec 88 pp 15-16*

[Text] This year the German Research Association (DFG) received 30 applications for major programs, the highest number of new applications submitted to date. For the first time, however, the DFG has only been able to accommodate less than half of the requests—a total of 14 projects.

Two of the new research projects in the field of biology and medicine have been assigned to Cologne and two to Giessen. A project entitled "The Modular Structure of Genetic Material" (Cologne) deals with the structure, function, and evolution of genetic material. The scientists involved in this project, which ranks among the foremost in contemporary biological research, anticipate new findings regarding the influence of the chromosomal environment on gene code. The second biological research project assigned to Cologne is entitled "Molecular Analysis of the Development of Cellular Systems" and aims at acquiring a better understanding of the normal development of cellular systems, including the analysis of developmental process disorders.

The special research project entitled "Pharmacology of Biological Macromolecules" (Giessen) will study the pharmacology of macromolecules as biocatalysts and cofactors. The scientists involved in the research project, "Molecular Bases of Decisive Processes in the Cell" (also in Giessen) see their principal task as analyzing the function of individual sections of gene loci by creating specific mutations, with the ultimate goal of contributing to an explanation of the regulatory relationship and interaction of genetic groups with host cell systems.

The study of the behavior of plants under stress is the focus of the new research project entitled "Ecology, Physiology, and Biochemistry of Plant Performance under Stress," carried out at Würzburg University. The project is subdivided into the following three topics: factors that limit and regulate photosynthesis, the effects of aridity and salinity, and the effects of atmospheric pollutants. Stress research is considered one of the most promising fields of botany. The target of the research project "Differentiation and Regulation of Energy-Converting Biological Systems," carried out at Düsseldorf University, is the comprehensive biochemical-physiological and microbiological analysis of the complex regulation and control processes responsible for controlling cellular energy conversion in specific organic cell systems.

The new natural science research project, "Hydrogen and Hydrogen Composites As Storable Energy Sources" (Stuttgart), will determine scientific principles and technical concepts for electrochemical production and storage of hydrogen and hydrogen composites. This research project is of international importance, and will pave the way for a revolutionary form of non-polluting energy production. The special research project entitled "Interaction in Molecules" (Bonn) will expand knowledge of various types of molecular interactions using basic interdisciplinary research drawing on abstract and experimental work. It is based on a concept unique to the FRG emphasizing interdisciplinary research in inorganic, organic, and physical chemistry and pure and applied physics. The special research project entitled "Organization and Reorganization of Π-Systems with Metals" (Heidelberg) is based on a concept whereby inorganic and organic molecules may be perceived as different manifestations of the same basic pattern. The goal of the fourth natural sciences project, "The Physics of Mesoscopic and Miniature Metallic Systems" (Cologne), is to undertake a methodically comprehensive study of the properties of complex substances with an irregular structure which, from the geometric point of view, must be classified as limited dimension systems.

There are two special research projects in the field of engineering sciences: "Assembly Automation Through

Integration of Design and Planning" (Munich Technical University) and "The Purification of Contaminated Soils" (Hamburg-Harburg Technical University).

The method adopted at Munich is based on an integrative study of design, assembly, and planning, together with concrete experience in design and assembly planning in automated assembly plants. The Hamburg Technical University will lay the mechanical, physical-chemical, biological, and biotechnological groundwork that will eventually lead to effective, economical processes for decontaminating heavily polluted soils. An additional goal is to identify means by which soils treated in this way can be revitalized and reclaimed for cultivation.

The DFG's board of directors declared another nine programs to be unconditionally qualified for subsidies. However, they could not be organized because the DFG lacked the funds. These projects include: "Molecular Plant Pathology," "Research on Science," "The Photochemistry of Heterogenous Systems," "The Eco-Ethology and Physiology of Social Behavior," "A Comparative Study of Past and Present Social Conflicts And Crime Control," "Microscopic Principles of Polymer Mixture Compatibility," "Novel Reactions and Catalytic Mechanisms in Anaerobic Microorganisms, "Surface Friction During Inelastic Shaping of Metallic Materials," and "Surface Magnetism."

The DFG regrets being unable to promise funds for these projects but hopes that they will be subsidized from other sources or that they will be submitted to the DFG again in due time. The DFG welcomes the 3.3 percent increase in its funds for 1989 announced by the FRG and the Land administrations. However, the large number of major programs that meet the DFG's strict standards but which cannot be financed proves that the 5.5 percent increase in funds called for by the DFG in its publication, "The Prospects for Research and Funding 1987-1990," erred on the side of caution rather than excess.

## EC Biotechnology Program Revised, Expanded

*3698M059 Brescia BIOTEC in Italian*
*Sep-Oct 88 pp 58-59*

[Article by Umberto Bertazzoni: "Revision of the BAP [Biotechnology Action Program]"

[Text] The revision of the EC's 1985-89 biotechnology program, known as the BAP, became effective in July 1988. The extension of the research program basically involves risk evaluation in the sectors of biotechnology, bio-informatics, and training. Approximately 4 million ECU will be spent for each sector over 2 years. In addition, there is a pilot project to sequence the yeast genome with approximately 2 million ECU in financing. The calls for bids relative to this sector were open to all research laboratories in the EC's 12 member states, and the selection criteria for the research projects were linked to the concept of supranationality. Also, the revision takes into consideration the problem of the Spanish and Portuguese laboratories' participation in the various research activities of the BAP, allocating approximately ECU 4 million for this purpose. In this case, selection criteria were not based on supranationality.

In connection with the field of "risk evaluation," 12 supranational research projects were chosen involving about 45 new contracting laboratories (in addition to the seven already active in this field), with a "ceiling" of approximately 55,000 ECU per laboratory per year. In this area of biosafety, special efforts were made to ensure the participation of laboratories from all EC member states. The research projects involve various aspects of risk evaluation in biotechnology, particularly the problem of releasing genetically modified organisms into the atmosphere. A large number of projects consider the dispersion of modified microorganisms as well as their detection, their interaction with plants, and the transfer of genes to other organisms. Two projects will study genetically engineered plants [piante transgeniche] and their behavior in the environment through experiments conducted in greenhouses and in the open. A new project will examine the risks common to the use of genetically modified lactic bacteria in the milk and cheese industry. Other projects concern the use of modified bacteria in the process of environmental decontamination, the use of the Baculovirus as a pesticide, and the use of virus vaccines as immunization vectors against rabies.

The strengthening of the bio-informatics sector involves the development of new software for this field and the use of new information technologies—particularly data banks and electronic networks—to support the organization of banks for cell cultures and protein engineering.

To achieve these objectives, about 15 supranational research projects (a total of approximately 30 contracts) were selected, with "ceilings" similar to those already mentioned in relation to risk evaluation.

The focus of the pilot project to sequence the yeast genome is on chromosome III. The project will combine the efforts of approximately 30 European laboratories which will receive approximately 2.3 million ECU in financing. This project is particularly significant because it will make it possible to obtain valuable indications concerning European-level coordination of future research activity on sequencing the yeast genome, as well as other organisms of interest in the field of biotechnology such as the bovine genome and other genomes of interest to agriculture.

The strengthening of the "training" sector is equally important. This sector will have a larger number of grants available to allocate through competitions open to all biotechnology sectors.

The extension of the program to include Spain and Portugal deserves a separate mention. These countries joined the EC only recently; in fact, they joined after the BAP biotechnology program had been launched and had

allocated all its funds. For this reason, it was decided to offer Spanish and Portuguese laboratories the option to participate in the program by submitting proposals relating to all the various sectors of the BAP. More than 30 laboratories were selected and will be integrated in the existing system through links of varying degrees of closeness with other European laboratories that already have contracts.

The revision of the BAP has been extremely useful in broadening certain sectors that were clearly expanding and had been underestimated, as well as in launching new projects and helping to improve the integration of European laboratories in a supranational system. The contracts will be financed for 2 years; the financing will cover the period between the end of this year and the end of 1990, thus extending beyond BAP and preparing the ground for BRIDGE.

## COMPUTERS

### France's SGS-Thomson Acquires Transputer Project

*36980120a Paris LES ECHOS (L'INDUSTRIE supplement) in French 18 Jan 89 p 7*

[Article by Henri Pradenc]

[Text] The world market of 32-bit microprocessors is dominated by three American companies (Motorola, Intel and National Semiconductor) and a British Inmos company, which has developed a new type of component: the Transputer. A processor specially designed for "the development of parallel architecture computers capable of competing with existing supercomputers", both in terms of performance and of cost, in fields as diverse as signal processing, simulation, image synthesis, and artificial intelligence.

The Transputer is a very special microprocessor; in its latest version the chip includes a computer unit that processes 32-bit data and 4,000 8-bit-bytes of random access memory as well as—and this is where it is unique—four communication processors enabling the component to exchange information at the speed of 20 million bits per second with four other Transputers. This latter characteristic facilitates the design of multiprocessor networks in which each computer unit works in close collaboration with its "neighbors". An opportunity that has already been seized by more than 70 manufacturers around the world.

In the United States, Floating Point Systems has launched a family of supercomputers—Series T—integrating from 16 to 16,000 Transputers! The British firm Meiko has produced a machine specialized in image synthesis called Computing Surface. As for the French firm Telmat, for several months it has been marketing the T-Node System, resulting from work performed as part of the Esprit Supernode project and consisting of "building blocks" able to accommodate up to 32 processors. The maximum configuration makes use of 1,024 Transputers for a theoretical power of 1.5 billion floating-point operations (Mflops).

The Inmos company was created in 1978 at Bristol with the financial participation of the British government. Among the co-founders is an English scientist, Ian Barron, one of the fathers of the Transputer. Six years later Inmos falls into the lap of the Thorn-Emi group to which the English government transfers its interests. But the mother company soon feels that the young company's business no longer fits in with its strategic line. In addition, Inmos loses money in the tornado which hit the semiconductor market in the years 1985-1986. Rumors of a sale begin to circulate.

#### Night Flights

Last December, Thorn-Emi and SGS-Thomson sign an agreement in principle stipulating that Thorn enters into the capital of the Franco-Italian group in the amount of 10 percent while the latter takes over the Bristol firm's business. Let us point that, in the meantime, Inmos has become profitable particularly by reason of the takeoff of sales by its star chip, which presently represents 20 percent of its commercial business (the remainder being derived from sales of specialized circuits and storage devices). Revenues for the year 1987-1988 amounted to $94 million.

The Thomson-CSF group evaluated the potential of the Transputer at a very early date. Its electronics laboratory at Rennes used it for processing high-definition television signals. The military branch of the group became interested in it for developing a night-vision system by infrared camera and for miniaturized-image processing devices to be used in missile heads. The component can also be employed as controller within peripheral equipment: for example, printers or diskette readers. Lastly, let us note that the Ximag Vision company supplied Thomson-CSF with a Transputer-based vision system for the inspection of welds on electronic cards.

#### The Component of Parallel Computation

In any case it is clear that the Inmos purchase provides the occasion for SGS-Thomson to make a bold entry on the 32-bit microprocessor market. Today, more than half of the Transputers are sold on the other side of the Atlantic, with Europe counting for 30 percent and Southeast Asia for a little less than 20 percent.

The Transputer is gaining a new market today, i.e., the one for extension cards used to "dope" microcomputers and work stations. A niche already invested by the German company Parsytec or the French firm Archipel. The latter has developed an "accelerator", called Volvox Par, which releases the host machine (IBM-PC or Apollo station) from certain computing tasks; the execution times are thus considerably reduced. By means of a

two-Transputer card designed by Parsytec, the Production Video Edition company has itself reduced from 50 to 5 minutes the time required for the creation of a synthesis image.

These past months the Transputer has become the component of parallelism. Its natural aptitude for communicating also makes it a processor of choice for the design of distributed data processing systems. CGEE-Alsthom is thus working on the design of an industrial control system to be used in a nuclear plant requiring more than 400 Transputers. One of the strong points of the device will be its high level of tolerance to breakdowns. Another example of large-scale industrial application of the component is the development by British Steel of an "intelligent" system complete with 48 Transputers to be used for production control in a steel mill in Wales.

A supplementary main-stream development which should be of particular interest to microelectronics-oriented SGS-Thomson is the design of integrated circuits for specific applications. In this order of ideas, Matra, the research laboratory of the Advanced National School of Telecommunications and the British company Logica, are working, as part of an Esprit project, on an auto-adaptive acoustical sensor, i.e., capable of automatically eliminating ambient noises. The signal-processing algorithms utilized for this purpose were perfected through use of a 32-Transputer Volvox card. Next phase: the integration of the all of these functions in silicon.

SGS-Thomson really has a very nice hand to play with the Transputer.

## DEFENSE INDUSTRIES

### First Successful Test Firing of 'MICA' Missile

*AN890090 Paris LA LETTRE HEBDOMADAIRE DU GIFAS in English 9 Feb 89 p 1*

[Text] Matra, in charge of development of the MICA missile, conducted a fully successful firing test against a CT20 drone in January 1989 at the Landes Test Center. This event demonstrates concept validity and technical options selected for design, notably: dual control of the missile by means of control surfaces and jet deflector; inter-equipment links via digital bus; strapdown inertia platform; in-flight target acquisition by the active electromagnetic homing head (AD4A) supplied by Electronique Serge Dassault, followed by accurate self-guidance up to target.

In January 1986, the French Direction des Engins/DGA entrusted Matra with development of the missile, designed to meet future requirements of the French Air Force and Naval Aviation combat aircraft. Like the one so successfully test-fired, the MICA can be fitted with an active electromagnetic self-guidance system (AD4A) or an infrared seeker. The latter version is now undergoing development by SAT and Matra. This missile is effective against remote targets, flying at widely different altitude from that of the launching aircraft, as well as against near threats attempting to slip away at short range.

### Italian, FRG Firms Develop New Generation of Tracked Vehicles

*MI890129 Rome INTERARMA in Italian 4 Jan 89 pp 20-21*

[Text] After two years of Italian-German collaboration on a new generation of tracked vehicles, INTERARMA reports that the AV-90 was presented at Kiel. The AV-90, developed by OTO Melara and Krupp MaK, is part of a family of armored vehicles being proposed as a substitute for the aging American M-113, of which over 50,000 currently exist in the world. In fact, the AV-90 is intended for the international market more than for the domestic markets of the two companies promoting it.

INTERARMA points out that this reveals the positive aspects of the AV-90's design philosophy. It uses reliable components (including mechanical parts already established in the most common type of civilian industrial vehicles) that are not subject to export restrictions (this is also valuable because it facilitates co-production agreements in the customers' countries). The AV-90's design also stipulates a maximum compatibility with the M-113 logistic chain for easier maintenance and availability of spare parts, as well as extreme simplicity and operational flexibility.

The joint development of the vehicle by OTO Melara and Krupp MaK unites the experience of two of the most qualified European companies in the field of armored vehicles. The experience of other highly qualified systems and equipment companies are also brought together in this program, including the FRG companies MTU and ZS for mechanical parts, and Italian companies—among them OTO Melara—for armaments. MTU, the engine company which also operates in the aircraft sector (among other things, INTERARMA recalls, it is a member of international consortia for the Tornado and EFA engines), is supplying the motor, an 8 V cylinder 183TA22 (DB OM 442A) with 368 horsepower at 2,100 revolutions installed on many large trucks throughout the world and produced under license in several countries. The cooling system, developed by Behr, guarantees the level of protection under a full load up to an external temperature of 55° C. ZS is supplying the automatic transmission and the steering system, an LG 1500 which uses the latest technology so that driving this highly manageable vehicle is easy for drivers with little experience. The tracks are standard for many models of lightweight tracked vehicles, and are readily available at low cost.

The body is composed of various thicknesses of welded aluminum, according to the ballistic resistance requirements of each part. This level of protection can be increased through the local addition of bolted steel plates. It is sealed with tin and can accommodate 12

people, including the tank leader and driver, using the latest ergonomic concepts. It is equipped with a hydraulically-operated rear port/ramp, as well as openings for shooting from the inside. The main weapons base can be made up of various types of turrets that distinguish the available versions.

The standard version, ABC (armored troop transport), has a machine gun protected by shields that can be lowered. The ambulance version obviously does not have this protection, while in the TUA (TOW Under Armor) version, it has been substituted by the ramp for the TOW antitank missiles. In the IFV (Infantry Fighting Vehicle), the weapon in the tower can be 20, 25, 60, or 90 mm. Finally, the version used for anti-aircraft defense contains a four-sided turret for 25 mm weapons similar to OTO Melara's SIDAM system, which was adopted by the Italian army.

**Vehicle Characteristics**

| | |
|---|---|
| Total Length | 6,000 mm |
| Total Width | 2,710 mm |
| Height | 1,720 mm |
| Weight | 15-20 metric tons |
| Road Operating Range | 762 km at 45 km/h |
| Off-Road Operating Range | 565 km at 45 km/h |
| Maximum Speed | 64 km/h |
| Vertical Obstacle | 0.70 m |
| Surmountable Trench | 2.00 m |
| Maximum Slope | 60 percent |
| Maximum Lateral Slope | 30 percent |
| Weight/Power Ratio | 24.6 kW/18.4 metric t |
| Fuel | 480 4 liters |
| Special Fuel Consumption | 145 g/hph at 1,300 revolutions. |

### France Military Space Budget Increased

*AN890079 Toulouse LA LETTRE DU CNES in French 12 Dec 88 pp 14-15*

[Unattributed article: "Sharp Rise in Military Space Research Budget"]

[Text] Next year France will speed up development of its military space programs. Budget figures for authorized programs will climb to Fr3.6 billion, representing an increase of 32.2 percent over the previous year. Payment appropriations will amount to Fr1.9 billion, an increase of 45.1 percent.

The major programs in the 1989 research budget are the Syracuse II program, the result of cooperation between the Ministries of Defense and of Post and Telecommunications; and the Helios program, the fruit of cooperation among European countries. The former program will be implemented in 1992 and the latter the following year, according to the timetable drawn up by Defense Minister Jean-Pierre Chevenement.

The Syracuse II military space telecommunications program is intended to replace Syracuse I, which will reach "the end of its useful life in 1991-1992." Like its predecessor, this system will consist of a military payload, on board a civil Telecom satellite, and relay stations.

However, the new system will have improved features, notably with respect to protection against communications jamming.

Next year, this technology will require funding worth Fr1.1 billion in payment appropriations (up 88.2 percent) and Fr2.1 billion in program authorizations (up 32.4 percent).

The Helios observation satellite program is being undertaken in cooperation with Italy and most probably with Spain. The cooperation agreement with Italy will allow that country to use 14.1 percent of the operational capacity of the satellite, while the anticipated agreement with Spain will give the latter the right to use 7 percent of its operational capacity. In order to carry out the program, each country will contribute to the cost of developing the system in proportion to its right of operational use; each country will also be able to set up image reception and processing centers. On the other hand, there will be only one control center.

In view of the entry into service of the Helios program in 1993, the credit appropriations for next year will increase to Fr499 billion (up 54 percent) and the program authorizations to Fr998 million (up 59.9 percent). Experts expect the satellite to have a 4 year lifespan.

## FACTORY AUTOMATION

### Finnish Textile Firm Develops New Control System

*36980167b Helsinki HELSINGIN SANOMAT in Finnish 21 Mar 89 p 30*

[Text]Tampella has developed a screw compressor control system which is very energy efficient and considerably extends the useful life of the compressors. Tampella has applied for a patent for its T.A.C.-system.

Within the framework of the Tampella heavy industry they have been working on developing the microprocessor-driven system for two years, with the ultimate goal of minimizing the compressor operation expenses as well as assuring the availability of pressurized air under all conditions.

With the new system control in operation, the compressor is functioning more evenly and its load bearing capacity is improved, when compared to the previous performance.

## INDUSTRIAL TECHNOLOGY

### Montedison To Establish New Industrial Chemical Center in USSR

*MI890128 Rome SCIENZA DUEMILA in Italian Feb 89 pp 77-79*

[Excerpt] [Passage omitted] Montedison is constructing a new plant for the Soviet Academy of Sciences in Ufa, Baskiriya using innovative technology. The plant will produce pure reagents (with a predicted capacity of 15 tons per year by 1990); in addition, there will be a pilot system for organic synthesis.

Also in Ufa, Montedison is constructing a plant for the annual production of 10,000 tons of polycarbonates using Soviet technology that was finalized in Montedison's research laboratories.

By introducing the possibility of joint ventures between Soviet and Western companies, the new economic direction initiated by the current Soviet political leadership cleared the way for a major new project. Montedison came up with the idea for this project, which involves the construction of an integrated chemical and industrial center to be established in Tengiz near the Caspian Sea. This new enterprise will involve the collaboration of Soviet industry with a consortium of foreign companies at both the production and the management levels. This consortium will be led by Montedison and consists of Occidental Petroleum, Marubeni, and Enichem. The consortium will co-own the plants that are constructed.

The Tengiz project represents the direction of future cooperation between the USSR and western companies due to its high level of technology. It will also be important because of potential production capable of reaching the large Soviet consumer market.

The project is part of the general process of detente and integration underway among diverse economies at the global level. Montedison is doubtless one of the leaders of this new stage of development in international economic relationships.

Montedison is actively participating at an important stage in the evolution of Soviet industry. The company is in a strong position as a result of its own technology as well as the experience it has gained in the USSR, and has consolidated this experience over the years through the changes in the economy.

This participation also concerns the field of research. The agreement for technical and scientific collaboration, renewed in 1984, emphasizes research issues involving products with a high degree of added value and high technological content. This was confirmed by the work of the 15th session of the mixed commission of experts: elastomers and fluoridated products, stabilizers and additives for polymers, intermediates for dyes, and catalysts.

Montedison's presence in the USSR—in its various forms: scientific, industrial, commercial, and technological—has continued for more than fifty years. During these years, both the Soviet economy and the nature of our group's industrial production have developed a great deal. Within this development, Montedison has assumed concrete form first in the transfer of technology involving chemical products for agriculture, and later with intermediates and organic products for industry. Finally, in the last few years it has concentrated on "science-based" production.

Montedison has transferred know-how, products, services, and resources and it has trained technicians. It has also created a "system effect" useful for Italian industry by involving more than 500 domestic companies supplying mechanical parts and products in its business in the Soviet Union.

Montedison's contribution of technology and engineering to the "chemicalization," and therefore the growth, of the Soviet economy was particularly significant in the field of nitrogenous fertilizers during the thirties. Technological cooperation in the sixties concerned chlorofluoromethanes, intermediates for fibers (rayon, ACN), and dyes. In the seventies and eighties, cooperation involved the fields of fine chemistry and materials.

Future prospects are represented by projects such as the one in Tengiz, where the economic development of new regions and the most sophisticated and complex cooperation between the USSR and western companies are blending in a very promising manner.

Montedison's presence in the joint venture project in Tengiz is therefore only the current and most complex stage of a long and rich series of successes beginning in 1933 in Gorlovka. This period has been characterized by mutual commitment and interest in social and economic growth, to which technology and the chemical industry have been contributing for decades.

## MICROELECTRONICS

### FRG Firm Produces X-Ray Stepper for Chip Production

*36980135 Munich INDUSTRIEMAGAZIN in German Feb 89 pp 104-108*

[Text] Suess—With the world's first X-ray stepper, an unbelievably precise keying device for mass production of the next generation of chips, two brothers are challenging the giant Japanese competition.

Their base in the lion's den is expensive compared even to Munich: DM 11,000 is the monthly rent that must be paid by Dr Ekkehard Suess, business manager of Karl Suess KG-GmbH & Co., headquartered in the Munich suburb Garching, for 160 square meters of office and service space in the new German Industry Center in Yokohama.

This is the site of the company's Japanese subsidiary, which was just established in early 1988 and which manufactures precision equipment for semiconductor production and markets it in Europe, North America and the Far East.

Still, Ekkehard Suess has no regrets about the expensive accommodations; first of all, he is getting by with paying much less money than he would if he were renting in the densely built-up Tokyo area. Secondly, thanks to its complete infrastructure, the complex is a good springboard for smaller firms in particular. Moreover, the address, which according to Suess is considered "one of the most modern office buildings" in the island nation, lends prestige among Japanese business partners.

Reason enough for a company that cannot ignore the customer potential of the Far East's world power on the chip market, and whose stiffest competition comes from Japanese firms, to choose this domicile.

From here, Suess is selling its latest and most promising product: the world's first X-ray stepper, which can be used for mass production of extremely fine chip structures. The machine is the key element of a new process technology that is intended to help produce much more efficient and faster chips than is possible today, since they are more densely packed with switching functions.

For the company specializing in equipment for labs and for small-lot production, with approximately 300 employees and a turnover of around DM 60 million, the X-ray stepper represents a venture into new realms of technology and business.

Depending on fittings, Suess is asking between DM 1.8 and 2.2 million for each system, which transfers the chip sample from the projection pattern (mask) to the silicon disk (wafer) with a high degree of precision, using weak X-radiation from a so-called synchrotron (particle accelerator). The XRS 200 is thus three to four times as expensive as the so-called mask aligner—an adjustment and exposure device for small lots, based on standard photolithography—for which the company is well-known in trade circles.

The costly technology of the X-ray stepper—an ingenious combination of precision mechanics, optics and microelectronics, both hardware and software—is not only valuable; it also motivated the brothers and managing directors Ekkehard and Winfried Suess to personally handle marketing and customer service on the Japanese market, just as with the United States in 1980.

This is because the Suess brothers now want to reap the commercial benefits of the developmental tour de force that has cost them "at least DM 15 million" from the firm's coffers since 1982, despite know-how assistance from the project partners and massive state subsidies.

They want to earn the money back primarily from Japanese chip producers, who are currently doing their very best to catch up with the West German alliance in the field of X-ray lithography. And they are apparently succeeding. While in the Berlin Submicron Project the single German X-ray source specially tailored for chip exposure—the prototype of the Cosy compact storage ring—is under construction, there are six or seven of them in Japan. Three of them are to be put into operation this year.

This opportunity should be taken advantage of before the Japanese optics giant, Canon, which is the absolute world market leader in standard wafer steppers, gets going with its announced development of a complete X-ray system with both storage ring and stepper. Suess hopes to get a good start in Japan this week with the XRS 200. It already has one order from the United States.

The Japanese electronics companies have definitely recognized the strategic significance of X-ray lithography as a key to producing 64-megabit memory chips. These third-generation superchips—following today's one-megabit chips—should be on the market by the mid-1990s. Other semiconductor producers, primarily in Europe and the United States, are still hesitating about getting on board with the new technology, even though X-ray exposure already promises tangible economic advantages.

They mistrust the difficult mask technology and are afraid that a compact synchrotron such as Cosy, at an estimated cost of DM 12 million, will only be usable at full capacity if eight steppers are connected to it simultaneously.

"Still, the more economic process always wins out," salesman Suess is convinced. After all, he has experienced this principle personally on several occasions, much to his regret.

At the end of the 1970s, for example, projection exposure using lenses superseded the then-standard contact-/proximity mask aligner—a Suess domain—in memory production, despite the high acquisition costs of the newcomer. And the Suess diamond scriber (dicer) for cutting finished wafers into chips was relegated to special applications by the advent of diamond saws.

Thus, flexibility—both in setting priorities in critical situations and in uncovering and seizing new opportunities—has been and continues to be a critical question for Suess. This is because medium-sized companies, in contrast to financially powerful conglomerates, cannot allow themselves to have too many irons in the fire.

The Suess brothers have proven more than once that they are flexible. The father, Karl Suess, founded the company as a commercial agent for the Leitz optics specialist in Wetzlar. By way of Siemens, one of their

customers, they soon noticed the growing need for equipment used in semiconductor production. And so little by little, the service shop, which modified microscopes accordingly, became a production operation, which built the first independently developed mask aligner for Siemens in 1964. Later on, the dicer and prober (high-precision bonding device for wafer tests) as well.

The brothers provided another example of their nimbleness when diamond saws began to displace the scribers, of which they were selling a couple of hundred each year. Although the Suess technicians themselves had begun developing saws, at the same time they had tackled a second innovation, the deep UV mask aligner, which permitted ultrafine structures of up to 0.2 micrometers in line width using ultraviolet light. Resources were lacking for both projects. After a sober analysis, the company heads abandoned the saw ("There we would have had to play catch-up").

They do not regret their decision: They have long since become the market leader with their mask aligner for exposing highly sensitive and fragile materials, such as gallium arsenide, or irregular shapes, primarily in the lab or in pilot and small-lot production. And with the new, more critical semiconductors, the scribers too are back in demand.

Thus, time and again the brothers must open up new niches for the existing know-how. They are helped in this by the fact that Suess, as a former marketing company, has never lost contact with the customer.

Nor do the brothers neglect research and development, however: Of the more than 300 employees worldwide, 15 percent are involved in this realm.

According to Winfried Suess, "one person alone could not have been able" to transform the former Leitz agent into a highly profitable producer of key technologies, with a turnover of around DM 60 million.

In fact, the two brothers complement one another perfectly: The elder Ekkehard, 57, a trained optician and trade school graduate in precision mechanics and optics with an additional bachelor's degree in commerce and vast business experience, handles the markets as business manager. Winfried, 53, with a degree in mechanical engineering specializing in electronics, and who as a small child repaired microscopes, is the head of technology for production at the Garching headquarters, at the Asslar subsidiary in Wetzlar (parts) and at the U.S. subsidiary in Waterbury Center, Vermont, but is primarily responsible for the company's innovation strategy.

**Linking Precision Mechanics and Electronics**

The brotherhood of market and technological know-how also allowed the two of them to venture into X-ray lithography in 1982.

At the time, Ekkehard and Winfried Suess were facing the question of whether for the next generation after their proximity exposure machines, in which the mask is projected directly on the close wafer without any special optics, they should build optical steppers or start something new.

One reason not to develop their own optical steppers, which expose single wafer segments successively, was the fact that as a newcomer, Suess would have to go up against strong competition—including the Japanese optics giant, Canon, which today dominates 85 percent of the world market.

Under those circumstances, the offer by the father of X-ray lithography, Prof Anton Heuberger, to develop an X-ray stepper together with Siemens seemed less risky.

This was not only because of the generous support provided by the federal government, without which Suess would "not have made it through the prototype." They also acted on the project because X-ray steppers also directly expose wafers from a short distance, and the Suess developers could thus use their experience with the mask aligner.

Moreover, the project demanded the highest "Made in Germany" mechanical precision, as Suess demonstrated not least of all through the samplers, as well as the capabilities of the electronics specialists of Karl Suss America Inc. They had to work out the complicated controls, because "the foundation in electronics is simply broader in the United States than here," Winfried Suess says soberly.

The stepper involves linking sophisticated mechanics and electronics, since structures 0.25 micrometers wide must be precisely adjusted by 0.15 micrometers. The goal is even 0.05 micrometers of tolerance with 0.1 micrometers of structural width.

This is possible using an automatic alignment or adjustment system thought up by Siemens engineers. It supplies statically determined measurement data by microscope and computer, through which the machine adjusts itself. Suess prepared the Siemens prototype for practical use.

**The Sales Trick With the Plasma Source**

On the whole, the Suess team had to combine a multitude of know-how building blocks to get the first X-ray stepper, Max I (1984), and its improved successor model, the XRS 200, both of which are at Heuberger's Fraunhofer Institute for Microstructure Technology (IMT) in Berlin.

The high-precision scales and motor operators, for example, come from German suppliers. The brothers are also full of praise for cooperation with the IMT specialists: "Learning from one another helped us a great deal."

In the meantime, the Garching developers have begun cooperating with other institutes as well. The company heads are hoping for even more impetus for their X-ray stepper business from a link with the Fraunhofer Institute for Laser Technology (ILT) in Aachen.

The ILT scientists helped to develop a so-called plasma focus source, in which the necessary X-radiation for the stepper is generated by gas discharge. Using this device, which Suess wants to introduce on the market in early 1989, a giant obstacle is overcome: Chip producers who want to adopt X-ray lithography no longer have to first install a synchrotron, costing in the millions; instead, they can test the new technology on a lab scale.

"So the inexpensive plasma source helps us," says Ekkehard Suess, "to sell the stepper."

## FRG Firm Develops X-Ray Resistant Material

*36980133b Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 22 Dec 88 p 8*

[Text] Within the framework of the cooperative agreement pertaining to the Bessy X-ray source, Hoechst AG in Frankfurt/Main took on the task of developing a suitable resistant material for X-ray lithography. The result is a new X-ray resist that satisfies all the requirements of mask structures in terms of sensitivity and accuracy of reproduction, with a practically unaltered process environment.

Photoresists are used to produce microelectronic components, and here in the manufacture of chips, in order to transfer the needed structures to the semiconductor substrate. To achieve this, a solution of the photosensitive material is first applied and dried evenly on the rapidly rotating substrate, for example silicon or gallium arsenide. The film obtained in this way, which is about 1 micrometer thick, is then exposed to radiation through an appropriate mask; in practice, UV (ultraviolet) radiation tends to be used.

Depending on the chemical principle, exposure at the points hit by the light results in an increased or decreased solubility in the developer that is subsequently used. In the former case, one speaks of a positive resist, in the latter case a negative resist. The semiconductor surfaces exposed by the developing step can then be etched and doped, meaning that their electronic conductivity characteristics are altered. However, metals can also be precipitated from solution or from a gas. The photoresist is subject to demands beyond those of pure photosensitivity and resistance. At present, for example, it must ensure a structurally exact, repeatable reproduction of structures measuring one micrometer or less in width, and must have processing tolerances that are as high as possible. In order to keep the rejection rate during chip production as low as possible, it is currently filtered to 0.1 micrometers. Finally, it must be possible to produce and process the material in mass, and it must be stabile in storage.

The weak X-radiation that is used in X-ray lithography has an energy level that is around 100 times higher than UV light radiation. It acts on the resist system on an atomic level, and in an initial step causes ionization, which is then followed by chemical reactions. The wavelength chosen for X-ray lithography—around one nanometer—is now dimensioned in such a way that an absorption of around three percent of the X-radiation per one micrometer of resist layer thickness is achieved for organic-chemical compounds. Because in this way the resist surface and the deeper layers of the resist are exposed to nearly the same X-ray intensity, the vertical edges typical of X-ray lithography can be achieved.

Even the low three-percent absorption level of X-radiation in the resist means that classical "AZ" lacquers can be structured. However, the necessary exposure time, even with a source of radiation as intense as the Bessy storage ring, is so long that it is impossible to conceive of a practical application for chip production. Particularly in the case of X-ray lithography, the search has been on for alternatives, whereby single-component resists have played a leading role for some time.

In the newly-developed X-ray resist, a starter compound forms a strong acid under X-radiation, and this acid subsequently decomposes a solution inhibitor based on an acetal or ortho-carbonic acid ester. These compounds interact strongly with novolak resins, while their decomposition products are very water-soluble. Alternatively, the acid formed in the exposure step can also be used to cause an acid-catalyzing chemical cross-linking reaction, whereby in contrast to the decomposition reaction described above, a negative image is obtained. Since in both cases the secondary reactions are catalyzed by the acid, meaning that the acid is not fully consumed in the secondary reaction, the process uses an intensification mechanism, which permits a lowering of the necessary exposure dose by a factor of approximately 100.

Furthermore, by retaining the novolak matrix, developing using the currently standard aqueous-alkaline developers is possible, and plasma-etching resistance also continues to be good. Distributing the various functions among the assorted chemical components is also advantageous in that to a considerable extent optimization can be conducted independently, thus doing justice to the necessary process characteristics, such as the sensitivity or dimensional stability of the generated structures, according to Hoechst's HIGH CHEM MAGAZIN.

Based on the various elements of chemistry, dealing with the X-ray resist demands not only the actual photoreaction, which results in acid formation, but also a subsequent dark reaction, in which the solution inhibitor

decomposes. This takes a significantly greater amount of time than in naphthoquinone diazine chemistry. Detailed kinetic and application-oriented studies have shown that at room temperature a period of time of approximately 15 minutes must be added for a complete reaction. Since developing speed depends on the concentration of the solution inhibitor, there are significant changes in the length of developing and in the width of the structures during this time.

The kinetic and application-oriented data obtained have been used as the starting point for extensive simulation and modelling calculations. The goal of this work, which is being conducted in conjunction with a group of researchers at the Fraunhofer Institute for Microstructure Technology in Berlin, is to gain a deeper understanding of the complex reaction sequences in the resist, in order to thus improve the resist specifications and its handling. Corresponding simulation programs for UV lithography have demonstrated their practical value, and make it possible to predict the structural reproduction under given exposure and developing conditions.

With this type of resist, it will be possible to produce gallium arsenide transistors with structural widths of 0.3 micrometers or narrower. This is of interest to the realization of ballistic transistors, with which significantly higher switching frequencies will be possible. However, these fine structures can also be used to produce memory chips with enormously huge memory capacities.

### EC Commission Criticizes JESSI

*36980133 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 13 Jan 89 p 8*

[Text] Munich—The timetable for the JESSI semiconductor project, which is to provide the basic technology for the next generation of semiconductors, is encountering criticism from the EC Commission. This was reported by Prof Dr Ingolf Ruge, managing director of the Fraunhofer Institute for Solid-State Technology, during presentation of the "Microtronics" program at the 1989 Hanover Industrial Fair in Munich. The FRG government is allegedly being accused of putting too much emphasis on basic research in this project, the planning of which is being conducted in the FRG.

Because of the lengthy planning period, the European electronics industry is reportedly in danger of losing its recently-achieved position in the field, which is on par with the Japanese and American competition. "JESSI is not coming along fast enough, and is too much oriented towards basic research," said Manfred Schmidt, managing director of Philips GmbH and head of Philips' Valvo components subdivision. Philips and Siemens, which are already cooperating in the Mega semiconductor project, were among the first industrial partners to participate in JESSI, in which other companies are now involved.

The JESSI report was presented by the planning group, Schmidt announced. However, he added, no decisions have yet been reached on what further official course of action should be taken. Ernst Hofmeister of Siemens also spoke out in favor of faster action. In the United States and the Far East, there is a consensus to the effect that only an independent microelectronics sector can strategically ensure the survival of future-oriented industry, Schmidt emphasized. However, this consensus is lacking in Europe, he said. If the battle for microelectronics is lost, then Europe will also be sacrificing its application-oriented industries.

The major boom in the semiconductor market, for which average annual growth rates of 13 percent are expected, will not be repeated in 1989 on an international scale, Schmidt said. For the United States, a clearly lower growth rate is expected compared to the 47 percent achieved last year. In the FRG, however, the rate of growth, which at 13 percent was based primarily on price increases in 1988, will gain a much broader and thus more solid basis.

## NUCLEAR ENGINEERING

### French Nuclear Engineering Firm Operates CIM Plant

*36980120b Paris L'USINE NOUVELLE in French 1 Dec 88 p 56*

[Article by Didier Gout "SGN: Factory Automation Assists Nuclear Industry"]

[Text] The development of an automated flame-cutting shop for the Chantiers de l'Atlantique shipyard strengthens SGN's know-how in factory automation. Specialized in nuclear engineering, this affiliate of Cogema thus widens its field of business.

Can factory automation take the relay from nuclear engineering? SGN [General Company for New Techniques] one of the first French engineering firms (Fr2 billion revenues this year, 90 percent in the nuclear industry), is finishing a fully automated flame-cutting shop for the Chantiers de l'Atlantique (Alsthom group) at Saint-Nazaire. The last private shipyard for big ships...

In a 450-meter shop, three robots—five-axes, Asea IRB 6, programmed "off line", driven in real time—are cutting more than 400 stiffeners per day. Each operation is preceded by a new computation of the robot trajectory after defining each profile axis by laser-triangulation and after marking the parts by ink jet.

"Previously, it required more than 15 workers who manually sketched some 45,000 stiffeners with the more than 150 shapes used in building an ocean liner," explains Guy Salemane, production manager. "The

result is a labor saving of about 17,000 hours per year on a total amount of 4.5 million hours, and an appreciable improvement in quality," he added.

Alsthom, which already has the largest passenger liner in the world "Sovereign of the Seas" to its credit, fully intends to make the most of this state-of-the-art industrial tool to obtain the order (that it is presently negotiating) for a duplicate of this ship. An order which would permit increasing the work load of the yard, but still insufficient to make both ends meet next year.

At SGN, there is less enthusiasm. The operation involving the Chantiers de l'Atlantique, billed at Fr15 million by the engineering firm, actually cost it much more: started in 1986, the completion required twice the anticipated time by reason of an under-evaluation of the software complexity. "In particular, it was necessary to rewrite completely the communication protocols between the computer, a Digital Equipment PDP 183, and the robots," one engineer confided. Quite aware of these difficulties, the general manager of the Chantiers de l'Atlantique, Jean-Noël Dacremont indicated for his part: "We are grateful to SGN for not having thrown up their arms."

Is this a setback for SGN? Certainly not, replies the engineering firm. First of all, because of this development, SGN has acquired additional factory automation know-how in the field of integration of complex systems. "We hope to sell this experience to other industrial sectors," explains Robert Lucas, in charge of their "techniques and industrial services" business. And then, by means of this operation, the affiliate of Cogema [General Nuclear Materials Company] and Technip is endeavoring to extend its diversifications outside of the nuclear industry. The big contracts covering the extension of La Hague retreatment factory are nearing their term, and knowing quite well that the technology transfer agreements—concluded with Japan, in particular—will not compensate for the expected reduction in work load, the company wants to take advantage of the nuclear know-how in other sectors.

This policy, unassertively started five years ago, is being confirmed today by Claude Aöberri, the new president named last October and is beginning to bear its fruits. For example, SGN was awarded the integration of the radar system for the "Poincare", which ensures the follow-up of missile sea tests. In production systems, two SGN affiliates, Game Ingenierie and Esia, have an order for a shop at Montparnasse railroad station devoted to the preparation of restoration platforms for TGV Atlantique trains, and an order for the distribution system of the 25,000 works of the City of Bordeaux library.

Will these diversifications be sufficient? Factory automation will not be a work horse comparable to nuclear engineering which, in the space of eight years, permitted quadrupling the company personnel (1,600 people today). SGN nevertheless hopes that these businesses, which involve nearly a quarter of the company payroll, will enable it to await, without too much suffering, the rebirth of the nuclear industry that certain experts predict for the 2000 horizon.

## FRG: ABB, Siemens To Build High Temperature Reactor in USSR

*MI890130 Berlin ETZ in German*
*No 24/88, Dec 88 pp 1142-43*

[Text] Asea Brown Boveri AG (ABB) and Siemens AG's nuclear engineering division have signed a general agreement for industrial cooperation on planning and building low output, high-temperature reactors in the Soviet Union. The Soviet partner is the Central Atomic Energy Administration (Glawatomenergo), which reports to the State Committee for the Exploitation of Atomic Energy (GKAE). The agreement was signed in Moscow on 24 October.

In the first phase of the agreement a large-scale prototype plant with a modular high-temperature reactor (HTR) providing a 200MW thermal output will be jointly planned and built at the NIIAR nuclear research center in Dimitrovgrad, about 800 km east of Moscow. Plans are also in the works to build additional plants to produce electricity, process steam and/or process heat both in the USSR and in other countries.

Working together as a consortium, ABB and Siemens' nuclear engineering division will supply materials and services with a yet to be established value for the planning and building of the Dimitrovgrad HTR. Agreements with the Soviet partner on planning, supplies, and assembly, as well as on a license contract, will settle the details.

The large-scale prototype plant to be built in Dimitrovgrad will be run at 700° C to 750° C for the first few years, after which there are plans for conversions to increase the plant's operating temperature to 950° C, to demonstrate high temperature process heat generation for the chemical industry and coal gasification. In the near future both sides will carry out joint R&D for this purpose as part of a project in which the Juelich Nuclear Research Facility and the GRS [Reactor Safety Society] will also participate. This research and development program follows the goals set out in the agreement signed on 22 April 1987 between the FRG Ministry for Research and Technology (BMFT) and the USSR State Committee for the Exploitation of Atomic Energy on scientific and technical cooperation in the non-military use of nuclear energy.

ABB and Siemens' nuclear engineering division see this as an important element in the cooperation developing between the FRG and the USSR on non-military use of nuclear energy. The construction of a pebble-bed HTR in the USSR, similar to those that have been under development in the FRG over the last 30 years, is seen by the

FRG partners as a milestone in this progressive technology. This should provide an impetus for the future introduction of HTR's on a commercial scale in both the USSR and in other countries. This contract also constitutes a long-term safeguard for the know-how gained over many years of work on high-temperature reactor planning and building. This knowledge is thus preserved for further exploitation in both the industrialized western countries and in other countries. The approval of the Coordinating Committee on East-West Trade (COCOM) must, however, be granted before substantial HTR technology can be exported.

## SCIENCE & TECHNOLOGY POLICY

### EC Commission Publishes Report on Technology Gap

*36980133a Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 30 Dec 88 p 8*

[Text] Brussels—The North-South gap in research and development within the Community is a cause of growing concern to the EC Commission. In its first report on the "Status of Science and Technology in Europe," the authorities in Brussels warn that the technology gap amidst the 12 member-states is achieving an order of magnitude of 12 to 1. This difference between the most progressive and the most regressive EC state is significantly greater than the overall economic gap, the report notes.

In the report, which has just been published in its entirety, the Commission points out that there are sharp contrasts in Europe, not only in the level of spending on research, but also in the role played by the private sector. The FRG, Great Britain and France together account for more than three-fourths of the Community's total public and private research expenditures.

According to the Commission's figures, Germany clearly has the highest level of research intensity, and industry in the FRG plays a much greater role in financing and developing research projects than in other countries. In Great Britain and France, in contrast, the share of research that is associated with armaments projects is very high. This reportedly makes it more difficult to coordinate programs within the frontiers of the European Community with both a civilian and a military focus.

The Commission notes further that in countries such as the FRG, the Netherlands and France, there is a strong emphasis on fundamental research. In other countries, however, the focal point is on industry-relevant research, which can be attributed to the constraints of public financing and growing demands for "measurable cost efficiency." Another factor is the rising cost of fundamental research, the report says.

### French-Italian Associaton Established for Technological Innovation

*MI890142 Rome RICERCA SCIENTIFICA E TECNOLOGICA in Italian Oct 88 p 18*

[Text] An announcement was made during the summit meeting between Prime Minister De Mita and President Mitterand concerning the establishment of the French-Italian Association for Technological Research and Innovation, AFIRIT. The association's charter had been signed on 19 October by the minister for scientific and technological research and by the chargé d'affaires of the French Embassy in Rome on behalf of the two governments. In addition to the minister for scientific and technological research, the Italian members of the association who signed the charter included the president of the economic affairs department of the foreign office, the president of the CNR, and the director general of ENEA, who was acting as proxy for the organization's president.

The founding organizations on the French side, which will play an active role in the association, include the Ministry of Industry and Land Use Planning, the Ministry for Research and Technology, and the Foreign Affairs Ministry. The association aims at encouraging cooperation between the two countries' industries in the field of industrial and technological research. In fact, the association's prime objectives are to promote contacts and exchanges among people, research institutes, and business enterprises in the two countries, to encourage and support cooperation in applied scientific research and technological innovation, and to facilitate the circulation of information and data.

The establishment of AFIRIT, which both parties had been anticipating for quite some time, ratifies and strengthens Italy's relations with France in the field of advanced technological research. It may prove to be a useful tool for future cooperation, especially in view of the establishment of the common market in 1992.

According to the charter, the minister for scientific and technological research, Prof A. Ruberti, will be the association's legal representative for the first three months. During this time, each country—and in Italy's case, the two participating research institutes as well—will appoint four government representatives as members of the board of directors. The remaining eight members will be elected at the first general meeting of the representatives of the participating industries, and shall be divided equally between the two countries.

### Italy-USSR Space Cooperation Agreement Signed

*MI890141 Rome RICERCA SCIENTIFICA E TECNOLOGICA in Italian Oct 88 p 17*

[Text] A cooperation agreement was signed by Italy and the Soviet Union on 14 October 1988 concerning the implementation of joint projects and the use of outer space for peaceful purposes. The agreement will offer scientists working in this sector the opportunity to

exchange information and data, and it will provide the basis for cooperation on the development of launch equipment and the implementation of joint in-orbit experiments. The initial term of the agreement will be 5 years, but it is understood that it may be renewed for additional 5-year periods.

Quite apart from its specific content, the agreement is of major importance both from the scientific and the political standpoints. As far as the strictly technical and scientific aspects are concerned, the Soviet Union is known to have vast experience and capabilities in the space sector. Italy, which in recent years has achieved a leading position in Europe and now ranks third in terms of its contribution and responsibility for ESA programs, is viewed as an increasingly active and influential player in scientific space activities both at the European level and in the wider international context.

As for the political implications, the agreement should be viewed in the context of the initiatives that are currently being undertaken in the space sector. In this connection, we must recall the recent agreement signed by Europe, the United States, Japan, and Canada for the development, launch, and utilization of the International Space Station.

If cooperation with the Soviet Union will enable Italy to improve its know-how in this field, it will also offer our country the opportunity to facilitate the Soviet Union's cooperation with other partners—especially those in Europe.

Undoubtedly, where new frontiers exist and new targets are to be pursued, humanity can find common ground for its efforts. From this point of view, space may be considered one of the new frontiers for the human race.

## Italy: National Strategy for Aerospace Industries Proposed

*MI890125 Rome AIR PRESS in Italian*
*27 Jan 89 p 139*

[Text] In Italy there is a need to have a "financial trust for aviation," subdivided into three groups: large aircraft, helicopters, and medium- to small-sized aircraft. This is the opinion of Fredmano Spairani, the president of RAI, the Italian Aeronautic Registry, expressed in an interview with L'UNITA. "It is necessary," he stated, "to establish a public financial trust for the overall aviation sector. It makes no difference whether it is associated with IRI or EFIM (although it could even be an independent entity). The first of the three groups would be involved in major civil and military aircraft, the area in which Aeritalia operates. The second group would be involved in the field of helicopters, in which Agusta is active. The third group, as I already said, would be involved in the area of medium- to small-sized aircraft, where there is room for our industry in the international division of labor. I believe that this is the way to rationalize and obtain results to avoid losing our place among aeronautic nations." According to Spairani, a "focal point" for aviation is not necessary, but he stated: "I believe that there is a need to draw up and follow a systematic industrial strategy on the national level. I cannot accept the fact that decisions on such topics as international collaboration, which have serious political implications and require enormous investment of public resources, are entrusted to the top level management of individual companies." According to Spairani, "The damages resulting from the lack of a plan for coordinating the aircraft industry are of a different nature: between 1983 and 1985, while the domestic group Agusta was making heavy use of national unemployment insurance and early retirement, Aeritalia hired 1,600 employees. This does seem to be a waste of human and financial resources that could have been avoided if there had been a national planning authority capable of rationally using existing resources."

Spairani fears the risk that Italy will become marginal to the aircraft sector, stating: "Our presence on the international market is a vital necessity. If we want to play a role in this situation, we must get out there with complete products that are complementary and non-competing. In particular, I'm referring to training aircraft and small- to medium-sized aircraft appropriate for use in light transport, civil protection, executive needs, etc. Our country is already present in these fields, and there are other important companies whose resources could be better used by coordinating them into a homogeneous group. These companies are Aermacchi, SIAI, Piaggio, Caproni, and Partenavia.

## FRG Industry Cooperates With Institutes, Universities on R & D

### Research Institute Contracts

*36980132 Munich HIGHTECH in German Dec 88 pp 72-78*

[Text]

**Contract Research Institutes and Their Presidents, Principal Fields, Number of Employees, Institutes and Turnover**

**Battelle Europe**, Roemerhof 35, 6000 Frankfurt 90, tel. 0 69/7 90 80.
- — President: Kabierschke.
- — Principal fields: Electronic systems with automation, physical electronics and software, engineering technology with energy, process, material and safety technology, biology and environmental research with motor and vehicle technology.
- — Number of employees: 7,500 worldwide, about 550 in the FRG.
- — Institutes: 6 in Europe.
- — Turnover: about DM 80 million.

**Cambridge Consultants**, Friedrichstrasse 5, 7600 Offenburg, tel. 07 81/3 40 71.

— President: Stolzenburg.
— Principal fields: Electrical engineering, machine building, computer science, design, biotechnology, sensor technology, optics, project management.
— Number of employees: not quite 230 worldwide, 15 in the FRG.
— Institutes: 2 in England, 1 each in the FRG and Singapore.
— Turnover: more than DM 30 million.

**Fraunhofer Society**, Leonrodstrasse 54, 8000 Munich 19, tel. 0 89/12 05 01.
— President: Syrbe.
— Principal fields: Microelectronics, computer science, production automation, manufacturing technologies, materials and components, process technology, energy and construction technology, environment and health, expert information.
— Number of employees: not quite 5,000.
— Institutes: 33 in all of the FRG.
— Turnover: DM 577 million.

The firm of Irion & Vosseler, manufacturers of counters for textile and packaging machinery, had devoted themselves to a labor-saving technology. As early as the mid-1970's the company in the little Black Forest city of Villingen-Schwenningen employed thermal printing in order to put numbers on the counter cylinders. About five million such cylinders are now produced annually with the self-invented cylindrical thermal stamping machines.

The company leadership refused to accept that this technology was good for just the one purpose. In fact, their thinking went, the method could just as well be employed to stamp the grooves of printed circuit boards.

For more than a year the Villingen engineers—working with as many as 25 men in the development section—searched for a solution. But the copper stamping material turned out to be recalcitrant, since it is very tough and does not break. Theo Mager, manufacturing and project leader at Irion & Vosseler, describes the difficulties: "We did not succeed in producing a conductive copper foil that was also imprintable."

A customer finally turned the company's attention to the Fraunhofer Society (FhG). After the first contacts, during which an exact project description was submitted, the Black Forest people met with skepticism from the Fraunhofer researchers. Finally, however, a preliminary study yielded initial approaches to a solution, and the project was begun in the early 1980's.

It took until 1984 before the FhG Institutes for Interface and Biomethod Technology, as well as for production and automation, proposed the manufacture of a brittle copper foil. The key element in the thermal printing of strip conductors is now a four-layer blocking foil with a base layer, a separation layer, a copper and an adhesive layer.

A heated stamp, whose upper surface shows the entire strip conductor image laterally reversed as a raised pattern, about 0.6 to 1 millimeter high, presses the foil onto the thermoplastic foundation. In so doing, the tracks separate from the copper foil, dissolve from the base layers and combine with the synthetic material.

This technology is as environmentally safe as it is fast, because no toxic exhaust air or poisoned waste water is created. And it takes 5 to 10 seconds per board to apply the strip conductors.

The system was shown for the first time at the 1987 Hanover Trade Fair. The many inquiries prompted the company to equip the pilot facility into a real production unit. This has been ready since the spring of 1988, and one is now beginning to open up the market.

Theo Mager leaves no doubt that the problem would scarcely have been solvable without the cooperation with the research institute. He stresses not only the assistance rendered in developing the method, but the advice in carrying out the planning and construction of the pilot facility.

The principal advantage of external research for the 360-employee company is described by Mager as the access to experts from the most varied professional fields: "We cannot afford to hire an expert for every problem that occurs in development."

In order to adapt the thermal printing process to the new application of their own efforts, Irion & Vosseler would have had to spend many times more the total of DM 2 million in development costs, of which the BMFT [Federal Ministry for Research and Technology] paid half. Mager's conclusion: "In-house development would certainly have been more expensive."

Cost benefits and time savings are nearly always mentioned when the customer is asked about the advantages of external research. At Hengstler Ltd. in Aldingen near Stuttgart there was something else as well: the lack of suitable employees. Managing director Juergen Elsner complains: "We lack engineers. We are always looking for some but can't find any."

When the manufacturer of time measurement equipment had to create an urgently needed second leg to stand on with a new product, the development capabilities of the 900-employee company were soon exhausted.

That is why Elsner turned to Cambridge Consultants in Offenburg, a subsidiary, specializing in middle-sized companies, of the U. S. project research institute Arthur D. Little. A specially designed study showed that the market for absolute shaft encoders—these are intelligent digital emitters for machine control which detect values even when the power goes off—is now still small, to be sure, but will grow tremendously in the future.

On behalf of Hengstler the researchers of Cambridge Consultants subsequently began to search for the innovative product. It took about 2 ½ years for a prototype to result from the concept. The development cost more than DM 1 million. The Hengstler people are now in the pilot run phase. Elsner says he is satisfied with the amount of time and the cooperation: "It went extremely well."

Companies such as Irion & Vosseler and Hengstler are no isolated cases, because the development pressure for small firms is growing just as it is for conglomerates. The increasingly tough worldwide competition, as well as the decreasing life cycles of many products, force even major companies to increasingly more research and development. Even groups as strong in research as Daimler-Benz therefore increasingly often award development contracts outside the firm, although project research in general is still in its infancy in the FRG.

As with temporary work—an American invention—external research is still suspect to domestic company people. They avoid surrendering their own know-how, filled with pride over former accomplishments, and believe that no stranger could offer them anything new in the familiar field.

And if for once they cannot get by without outside development assistance, they perceive it as an embarrassment and spread a cloak of oblivion over it.

It is entirely different in the United States. There, company heads apparently have a less emotional relationship to their inventions and products. Otherwise chemist Arthur D. Little would scarcely have had any success when, 102 years ago, he founded in Boston the first private research institute in the world, which was available exclusively to paying customers. Today, ADL with 2,600 employees is still counted among the leading project research companies in the world.

The first company to offer these services has been overshadowed by competitor Battelle Memorial Institute in Columbus, Ohio. The institute was founded in 1925 at the initiative of American steel industry magnate Gordon Battelle and with 7,500 people today ranks as the largest project researcher in the world.

But the market leader, above all, has found out how difficult it is to do business with borrowed creativity in the FRG.

Battelle in Frankfurt, which counts among its customers firms such as AEG, BMW, Bosch, Braun, Ford, Henkel, KWU, Mannesmann, Preussag, SEL, VW and Zeiss, was in the red for years. Spoiled by government contracts, the institute had paid too little attention to the needs of its industrial customers.

Meanwhile, the head of Battelle Europe, Thomas M. Kabierschke, has a different philosophy. The management of the renowned institute has recognized that the industry, formerly more interested in basic research, ideas and laboratory studies, today strives for product development closely tied to the market. Says Kabierschke: "We are developing into a technology center and systems facility."

The Fraunhofer Society has this step almost behind it. With more than 4,500 employees and 35 institutes in the most varied professional fields, FhG, publicly financed and with a nonprofit classification, is the undisputed market leader in the FRG in the business of rental intelligence.

Meanwhile, the contract researchers have long since stopped being restricted to purely basic research in the laboratory and have increasingly oriented themselves toward the demands of the markets.

Their spectrum of services includes market analyses, development and improvement of products and methods, manufacture of prototypes, advice for test production and for the transition to series production, and the FhG brain trust even puts together organizational and marketing concepts, if desired.

And when the institutes have a product idea, they approach a potential user. In this manner the Staiger watch company in St. Georgen in the Black Forest acquired a new high-tech product: in 1985 the Fraunhofer Institute for Solar Energy Systems, in the context of an event organized by the Watch Industry Association, presented the possibility of operating a watch with the help of sunlight.

The Staiger people were excited, since as early as 1977 they had in vain tried to gain the necessary power from fluorescent-activated light sources. At that time, however, watch technology was not advanced enough and light-gathering materials not stable enough. The problems now seemed solvable with FhG's system named Fluko.

Together with the FhG researchers, Staiger developed a watch with a face made from a highly transparent synthetic material, into which a special fluorescent color has been worked. This material gathers light, concentrates it and transmits it via a mirror system mounted on the edge to seven solar cells arranged side by side. The power produced in this manner is stored in an accumulator.

Staiger, a 430-employee company with a DM 60 million annual turnover, has meanwhile acquired the patent and pays a licensing fee of two percent of the sales price to FhG. Development leader Reinhard Jaeckle openly admits: "They helped us open up a new segment."

The Staiger man considers it impossible for a middle-sized company to get by today without close contact with such institutes. The technical demands are too extensive for one company alone to master, primarily when it involves new fields of technology. That is why the company is seeking support from the nonprofit idea men in yet another field, that is to say thin-film technology.

In order for the transfer of knowledge to succeed, it is recommended that a few basics be observed: A good cooperation can only grow when the company is quite clear about what it really wants. The contract researcher only needs the most accurate description of the task possible.

The costs are usually calculated according to the necessary requirement of man hours. The rates charged by the institutes for a scientist range between DM 12,000 and 25,000 per month. Theo Mager from Irion & Vosseler kept the development costs for the printed circuit board manufacture under control by dividing the entire undertaking into small steps. Before each step, the expected costs and results were examined and each time a new decision was made as to whether one should continue. Not until then did they give the green light to the next step in the contract researchers' action plan.

Almost as important as financing is, according to Reinhard Jaeckle from the Staiger watch company, the personal contact between the in-house and the hired developers. Before he awards a contract, he demands that the people involved get to know each other thoroughly. If the chemistry is not right, there will be no contract.

According to the experiences of Wolfgang Moeller, department head at tool manufacturer Andreas Stihl in Waiblingen, it took more than a quarter of a year until the contract researchers had adjusted to the firm, its products and technologies. The company needed the help of a contract research institute when assembly had to be restructured in such a way as to permit flexible working hours.

Moeller evaluates it as positive that the research crew allowed existing know-how to combine with the organizational and technical design of the assembly, showing various alternatives and presenting an evaluation system for the various criteria of the solution possibilities. The man from Stihl was most pleased that the planning system of the hired brain workers transferred to the company's own personnel and resulted in goal-oriented working.

In the Swabian company, which employs a total of 5,500 workers and has a turnover of about a billion DM, there is less satisfaction with a frequently criticized phenomenon in contract research: "The research personnel changed too often."

Moeller also criticized the way newly hatched university graduates in part often discussed trivialities with the experienced hands and would not understand that the men with practical experience often knew more about the actual procedures and difficulties. In order for everything to come off, in his experience, there must be someone in the company who deals exclusively with contract research. Says Moeller: "Anyone who cannot afford that, will have a hard time."

## Interview With Fraunhofer President

*36980132 Munich HIGHTECH in German Dec 88 pp 78-79*

[Interview with Fraunhofer president Prof Max Syrbe: "Secrecy Is Out of Vogue"]

[Text]

HIGHTECH: Professor Syrbe, when it comes to contract research, many companies cover themselves up. Why?

**Max Syrbe:** When it was a matter of evaluating one's own know-how over long periods of time, the companies worked with extensive secrecy. That may have been correct at the time, because they made their living from the fact that others did not have the knowledge.

This situation has changed fundamentally today, because anyone can acquire information about the state of technology by gathering knowledge from data banks and periodicals. That is why the speed with which they use the new knowledge is important to companies today. A company becomes strong through its ability to recognize market opportunities and to use them quickly.

HIGHTECH: And where lies the usefulness of contract research?

**Max Syrbe:** Contract research comes into play precisely because of this change. When a firm determines that for example a product is no longer selling, it has to acquire expert capability very quickly. Previously in this case one advertised, employed people and waited for the result. Today, everything must go much faster. Contract research institutes take care of the rapid turnover, because they solve problems based on the situation and usually offer not just one, but several scientific disciplines. And when one has made use of them, one is immediately rid of them again.

HIGHTECH: Is contract research a possibility for smaller firms as well?

**Max Syrbe:** Yes, for them it is even crucial for survival. Of course, the company must bring forward certain capabilities in order to deal sensibly with contract research. The most important thing is one's own R & D capacity. We have determined that industrial results are proportional to the number of employees in the R & D

department. Second, the entire management must be intent on making product innovations. And then it must know the R & D service market, so that it turns to the right institutions.

HIGHTECH: Which are the most important criteria for successful cooperation between client and contractor?

**Max Syrbe:** Well, the client's management must first be willing to start something new. And the capability must be there to recognize that solution alternatives exist for every problem and that each problem is tied up in an entire complex of problems. That is why each task must be viewed from a systematic aspect.

Whoever possesses all of that is generally capable of saying, I don't have to have invented everything by myself.

HIGHTECH: When this basis exists, what else is important for successful cooperation?

**Max Syrbe:** Above all open discussion of problems. Our people need a partner who cooperates with them so openly that they can identify with his problem.

HIGHTECH: Where are the limits for a contract research institute?

**Max Syrbe:** I have to apply that to the Fraunhofer Society, which is a nonprofit organization. That means: If the service we can furnish can be offered at about the same price by a private enterprise, we have to withdraw from this field. At the point when business enterprises can solve their problems between themselves, the public, nonprofit research organization has nothing more to do in this place. Beyond that, we always understand our achievements as being help for self-help, because the actual conversion for the market must be undertaken by the company. The goal is therefore ultimately for the company itself to have the whole thing in hand.

HIGHTECH: What does that really mean?

**Max Syrbe:** For a new product we accompany the clients even to the press conference and to the professional trade fair, in order to make the customers aware of the particular advantages. In systems technology we go as far as the start of operations, as we did for the Bremen plant of Daimler-Benz, for which we delivered the process control system, a precursor of CIM [computer-integrated manufacturing] technology.

HIGHTECH: Does that also mean that when the businessman has difficulties he can easily call once more after the contract has ended?

**Max Syrbe:** Naturally.

HIGHTECH: Don't your clients often fear that their know-how will get out?

**Max Syrbe:** There are surely some reservations there. But technical knowledge can no longer be protected today. That is why competitive power does not lie in keeping knowledge secret, but in the ability to implement it quickly.

HIGHTECH: Does a development remain secret if it is made by one of your institutes?

**Max Syrbe:** Of course we guarantee confidentiality. We require it of our employees, and as of this moment I know of no cases where we might have violated such promises.

HIGHTECH: What would you point out to a company that so far has never contracted for outside research?

**Max Syrbe:** That keeping secrets and isolating oneself no longer is an advantage and that the important thing today is to acquire usable knowledge as rapidly and cheaply as possibly.

## Industry Think Tanks

*36980132 Munich HIGHTECH in German Dec 88 pp 80-82*

[Text] Before the client even has time to express his wishes, he gets into the VIP carriage. At a speed of 250 kilometers in the home stretch, it becomes unmistakably clear to him that this is no ordinary research facility.

The lap of honor as a passenger in the superfast sports car is part of the ritual at the Weissach Porsche development center, similar to the test of courage for acceptance into a college fraternity. Not everyone finds this a supreme enjoyment: One visiting woman fainted during a curve taken at dizzying speed....

Whether the Porsche top brass want to assure themselves of an advantage in the tough poker game for contracts, is an open question. The fact is: Anyone who gets out of the racer on more or less shaky knees is at least properly impressed.

This remains so even after the subsequent tour of "Germany's number one factory think tank," according to the industry paper AUTO MOTOR UND SPORT. For what is concentrated on 49 hectares of former agricultural land at the gates of Stuttgart in the way of test stands, process computers, testing laboratories and construction offices, must in fact make the heart of every technician beat faster.

But not only that of the engineer: At Weissach managers, developers, buyers, marketing directors of large and small companies come calling, because almost one out of every two of the 2,200 engineers and technicians in Weissach does not work for Porsche but for outside clients. About 150 of the DM 400 in annual turnover comes from the wallets of external customers.

For example, Soviet automaker Lada contributed not quite 100 million to the turnkey development of a new four-cylinder compact, which meanwhile is obtainable here as well under the name "Samara."

"In principle we name no customer names," says Wolfhelm Gorissen, head of the External Development business department, "but you can assume that there is hardly an automaker in the world who has not had us develop and research for him."

What, then, moves companies such as Daimler-Benz or BMW—on the autobahn usually bitter competitors to the snappy little sports cars from Zuffenhausen—to contract for work in Weissach, of all places?

"Because they want to profit from the synergy effect," Gorissen maintains. "There simply is no comparable construction office in the world, which can draw on so much varied knowledge from a variety of sources and has such close exchanges with other manufacturers."

Further, it can scarcely be avoided—despite all the discretion—that the knowledge gathered from one customer project overflows into development for other companies, or, respectively, appear in Porsche's own models. Says Gorissen: "Everyone knows, of course, that the knowledge gained in many projects will benefit the next customer."

But the Weissach technicians do not get their initiatives just from the automotive field. For example, the revolutionary cockpit design of the Airbus A320 comes just as much from the CAD systems of Porsche developers as do new types of jumping mats and gas masks for firemen. The repertoire of customer projects has recently included power plants for air ships and racing boats, mining machinery, tracked vehicles, systems for reducing noise in compressed air construction machinery and finally even the construction of an aerodynamically designed skibob. The most stylish forklift truck of all times was developed by the Porsche people at the request of the Linde company—to Gorissen "a prime example of cooperation with an external customer." After the first contact, a cost estimate was worked out to begin with, followed by a concrete performance description with the exact formulation of all specifications. Then, when the contract had been signed, Porsche designated a project leader, who had to coordinate the work of the various divisions.

During the development, Linde regularly received status reports as well as a monthly bill for costs according to expenditures. After Porsche took internal delivery of the prototype, the streamlined load lifter was officially presented and turned over together with the construction drawings. Says Gorissen: "Everything on schedule and exactly according to the cost plan."

The Weissach model of a development center that lives largely on outside contracts is both a throwback to the early history of the company—Ferdinand Porsche built fire-fighting trucks for the Vienna fire department before he started on his "Strength Through Joy" Beetle—and a profitable chess move. Today, Porsche calculates only seven to eight percent of the overall costs of a car for development—not much, with regard to the low production figures. Weissach obtains the rest from external contracts. Gorissen even admits that "if necessary we could also earn money in Weissach without the sports car production."

In this respect, the economical Swabians are rather unique, because no other industrial enterprise, which does research and development for external customers, admits that these activities are profitable. In general, the readiness of private companies to give out information about external research is highly underdeveloped. Some fear getting a reputation of needing such contracts, others simply want to protect their clients.

For in the FRG, in contrast to the United States, perhaps, the unwritten law prevails: "Only what is conceived in the company is well done."

This has not been true for a long time: Even firms such as Siemens or Nixdorf sell products that were not only conceived but completely produced elsewhere. Without these so-called OEM [original equipment manufacturer] goods, no German manufacturer could sell for example a telefax machine or a large computer. But admitting that an in-house product was developed by foreign brains is incredibly difficult for most company directors. While American manufacturers openly brag about a certain product originating from the Bell Laboratories, for instance, or from MIT, their colleagues in Old Germany are as embarrassed as if they had been caught cheating on their wives. And that rubs off on the industrial contract researchers, of course, who would prefer to keep silent about their very existence.

At the MBB aerospace group, where demonstrably not just the impact bowl for the airbag systems were developed by Daimler and BMW, Horst Prem from the development division says peaceably: "Contract development for outsiders—that is nothing for us, we have no time for that."

To Rolf Kottmann at Interatom in Bergisch-Gladbach, external contracts are nevertheless a waste product of intensive internal research work. Of the approximately 1,000 engineers, physicists and technicians at the Siemens subsidiary in Bensberg, only 45 are in his New Technologies department and thus active in outside work.

There, however, "everyone is welcome, from the smallest shop to the big companies." Companies signing contracts profit as customers from the technological progress in nuclear technology, with which Interatom

has been involved for decades. The development center has thus produced pioneering work in new materials and in surface analysis. The Bensberg people also possess concentrated expert knowledge in the difficult combination of ceramics and metallic building materials.

The biggest hits in the Rheinlanders' supply of services are extensive computer simulations, such as of the behavior of the gas flow in the cylinders of internal combustion engines or of temperature behavior in heat exchangers or gas turbines. The in-house computer system also delivers expert systems, for example in order to monitor factories or to optimize planned pipeline systems. Says Kottermann: "We have everything needed and can offer such solutions faster and usually also more economically than someone who first has to get the necessary equipment and experts."

Anyone seeking ideas from the assembly line of the development centers of major industrial enterprises can also find them at:

- MAN Technology in Munich. In addition to auto and truck manufacturers, the subsidiary of the MAN group counts among its development customers machine and facility builders, space corporations and recently even companies specializing in pharmaceutical technology, who had new types of arm and leg prostheses developed.
- Dornier in Friedrichshafen. To be sure, the aerospace company "operates primarily for the other members of the Daimler-Benz group" (company spokesman Rolf Christ), but occasionally makes its wind tunnel for buildings, unique in the world, available to outside clients for testing complete structures or develops traffic control systems, electronics for control systems and other technical sophistications.

Only in rare cases does it ever happen that a development center has to declare itself not qualified.

Wolfhelm Gorissen at Porsche in Weissach says: "Years ago someone called us and said: 'You build such fantastic racing cars. Couldn't you make us an artificial heart?' First, we found the idea intriguing, but then we had to say no thanks. Otherwise a few of our engineers would have had to study medicine first..."

**Company Research Centers**

— Porsche Development Center, 7251 Weissach, tel. 0 70 44/35-1.
— Dornier System GmbH, Postfach 13 60, Friedrichshafen, tel. 0 75 45/81
— MAN Technology GmbH, Stadtbachstrasse 1, 8900 Augsburg, tel. 08 21/32 21
— MBB GmbH New Technologies, Postfach 80 11 09, 8012 Ottobrunn b. Munich, tel. 0 89/60 00-1 63 69

**Companies Specializing in Contract Research:**

- Gesellschaft fuer Fertigungsforschung mbH [Society for Production Research, Ltd.], Rheinstrasse 32, 6100 Darmstadt, tel. 0 61 51/2 68 34 (Special field: machine-building);Gesellschaft fuer Informationsverarbeitung mbH [Society for Information Processing, Ltd.], Bergstr. 13, 7000 Stuttgart, tel. 07 11/21 62 28 (Special field: information technology);IBS Ing. Buero K. P. Schmidt [IBS Engineering Research K. P. Schmidt], 4020 Mettmann, tel. 0 21 04/2 39 58 (Special field: sound and oscillation technology);
- Bauz Interfacetechnologie und Prozessautomation GmbH [Bauz Interface Technology and Process Automation Ltd.], Kirchhofsallee 14, 2370 Zeven, tel. 0 42 81/15 77 (Special field: machine tools);
- Holtschmidt Entwicklungen OHG [Holtschmidt Developments, gen. partnership], Heinrich-Hertz-Str. 2, 8900 Augsburg 21, tel. 0821/8 00 30 (Special field: machine tools);
- Interatom GmbH, Friedrich-Ebert-Str. 5060, Bergisch-Gladbach 1, tel. 0 22 04/8 40 (Special field: solar energy);
- MEC Maschinenbau Entwicklungen Consulting GmbH [MEC Machine-Building Developments Consulting, Ltd.], Duerener Str. 243, 5180 Eschweiler tel. 0 24 03/2 30 91 (Special field: machine-building).

## University Contracts

*36980132 Munich in German Dec 88 pp 86-88*

[Article: "Tips From the Professor on Loan"]

[Text] The big players among contract researchers with civil servant status at the German institutes of higher learning pull down annual incomes such as most industrial bosses can only dream about. They head up institutes as large as medium-sized companies and employ dozens of assistants. But pure teaching takes up only a tiny portion of their strictly limited time; for the great remainder they devote themselves exclusively to their clientele in the private economy.

They develop automated production systems, as does Berlin professor Guenter Spur, or assembly robots, as does his Stuttgart colleague Hans-Juergen Warnecke. And they can pride themselves that they have contributed quite significantly to the high standard of the German production technology.

Gone are the times when the alma mater accommodated a closed society, where science closed itself up in ivory towers and shunned every contact with harsh reality. On the contrary: Politicians in all the federal states are busily making efforts like never before to open wide the doors of their advanced schools to the companies. Technology transfer is the key work of the 1980's. Now, academic service is marketed with partly professional methods.

Those who benefit from this new trend are primarily medium-sized and small companies, which cannot afford their own R & D departments. But with a hired academic—it doesn't always have to be a professor—this

becomes possible. It is affordable and in principle costs no more than a management consultant. In addition, there is a wealth of public support programs, from subsidies to credit assistance and venture capital, at the federal and state level and within the framework of the EC.

The supply of German universities and technical universities, technical institutes and professional colleges—together with the cooperating institutes and institutions—is tremendous. There is a kind of buyer's market here, and the businessman as customer has his choice. For example:

- In Berlin, 180 institutes conduct application-related research and development, among them a whole series of so-called An institutes—these are private institutes in the framework of an institute of higher learning. Among them are the Engineering Society for Aggregate Technology and Traffic Vehicles (IAV) and the Institute for Railway Technology (IFB), both at the Free University, as well as the laser medicine center of the Free University.
- Kiel University is establishing its research specialties in marine technology, gene technology and information technology. There is also research in solid state physics (specialty: solid state diodes, solid state laser).
- The Institute of Natural Science and Medicine at Tuebingen University in Reutlingen (NMI) has been working for 3 years on the conversion of basic research in these areas "into industrial practice." Among the first projects are articulated prostheses with a long lifetime, catalysts for exhaust gases from coal-burning power plants, as well as an improvement in floor heating.
- Bremen University is proud of its CAD-CAM laboratory at the Bremen institute for operational technology and applied ergonomics, which has as its goal to help put the most recent research into practice.
- In Duesseldorf the Joint Center for Surface and Microfield Analysis, founded just last year, is offering itself to medium-sized companies as a service enterprise for materials research such as surface testing, tests of auto paint or corrosion protection.
- Several North-Rhine Westphalian institutes of higher learning have formed a plasma physics working association oriented to practical applications.
- Contact people for laser technology can be found at Erlangen-Nuernberg University.
- Ecological specialists for analysis of waste and other environmental burden offer their service at Saarbruecken University.
- At Freiburg University access time to major equipment is rented to companies, such as for the scanning electron microscope, the monochromator or the grating spectrometer.

To these are added service offers from research and training in the problems concerning high-tech products. At the Berlin Technical University, for example, managers and owners of medium-sized companies sign up to get information through quick courses on market trends and on marketing and management problems for new products.

In this field even the humanities departments have discovered new market niches. The Cologne sinologists, for example, offer their help with China contacts. In neighboring Duesseldorf an East Asia institute has now been established, financed by the business community, as well as a university professorship on modern Japan. The language and culture specialists want to gain a new audience with the slogan "Export Opportunities Through Cultural Knowledge"—joint seminars have already been held by the philosophy department and the Duesseldorf Chamber of Industry and Trade on such topics.

But the technology transfer is not limited to spectacular projects; the majority of the work is carried out on a small scale. This is shown by a survey by the East-Bavarian Technology Transfer Institute (OTTI) in Regensburg. Nearly one out of every two college degree candidates in the technical fields is involved with an industrial problem.

Students like to look for their thesis topics in companies, since they expect better opportunities for starting their career, which results in about one-third of the projects for the companies being free. The paying companies here usually receive very inexpensive solutions to their problems, between DM 400 and 14,400 per job in total expenditure.

The profit and loss account, according to the OTTI study, is evident: Only 10 percent of the companies found no opportunity to use their degree candidates' results; another 10 percent were of the opinion they could use the work "maybe later." The remaining customers were happy with the total or partial usefulness. A conglomerate-owned R & D department can only dream of such a ratio of success.

This form of technology transfer has turned out to be particularly suitable for small and medium-sized companies, not merely because of the low cost. For in such companies, OTTI employee Michael Dusch says, there are often reservations against external know-how; exclusivity is valued. In this case masters-degree work in a firm is exactly right—after all, masters work, unlike doctoral dissertations, does not have to be published. (The OTTI study "Diplomarbeiten als Instrument des Wissens- und Technologietransfers zwischen Fachhochschulen und Unternehmen" [Masters-degree work as an instrument of scientific and technology transfer between technical colleges and enterprises] is published by Bock Verlag in Bad Honnefer.)

Degree candidate contacts between technical colleges and enterprises develop regionally, but the major universities and institutes of higher learning prefer to acquire them beyond regions. There are now five dozen transfer

centers on the higher education level, which are trying to market the supply from their institutions. Transfer facilities which are attached to one or more higher education institutions work similarly. Examples are:

- the Steinbeis Foundation in Stuttgart
- the Technical Advisory Service in Bremen
- Technology Consulting by the technical colleges of Schleswig-Holstein in Kiel, and the
- Technical Advisory Service of the technical colleges of Schleswig-Holstein in Kiel.

For the 14th time the higher education institutions will be represented at the Hanover Trade Fair. "The universities have learned marketing," comments fair coordinator Siegfried Neumann, and says that the word contract research now no longer triggers emotions the way it did 10 years ago.

At the Hanover Trade Fair there might possibly, as in previous years, be interesting transfer offers from the GDR, since in some fields its research is of top quality, but there is a lack of economic base in order to evaluate it.

However, businessmen who have to solve a certain problem with academic help are best served by a more demand-oriented advisory facility in their region. The employees there know the research scene, they provide not only the right contact person but also know which sources of support should be tapped in each case. Such advisory offices exist in nearly all states:

- Oberhausen: Municipal Technology Advisory Service for the Ruhr area,
- Berlin: Technology Referral Agency (TVA),
- Bochum: Technology Advisory Office for Ruhr,
- Frankfurt: Innovation and Technology Advisory Office for Hesse,
- Hanover and others: Innovation advisory offices of the Lower Saxony chambers of industry and commerce (IBS),
- Kiel: BITT Schleswig-Holstein, Advisory Office for Innovation and Technology Transfer,
- Mainz and others: Advisory Office for Innovation and Technology Transfer (BITT) in Rhineland-Palatinate,
- Regensburg: East-Bavarian Technology Transfer Institute (OTTI),
- Saarbruecken: Saar Center for Productivity and Technology (ZPT),
- Stuttgart: Central Office for Technology Advice of the Baden-Wuerttemberg State Enterprise Agency.

Technology transfer advisors are also present on the Rationalization Committee of the German Economy (RKW) and in the chambers of industry and commerce, as well as in the branch organizations.

In the few years of its existence, the technology transfer field has already branched out in so many ways, that it requires scientific work to maintain an overview over them. This is what diplomate engineer Wilfried Baersch and his coworker Ulrich Roecher are doing at the Siegen joint university technical college. His "Catalog of Support for Technology Transfer" has now appeared at the publishing house of Rhineland TUeV [Technical Supervision Administration] as a collection of loose leaf pages (414 pages, DM 98), and is constantly updated. The information is available on diskette and can then be integrated in any computer data bank.

The data collection includes contact addresses at institutes of higher education, in business and at state offices, supplies information about research concentrations, about federal, state and EC project promotion programs, as well as about the sources for venture capital.

After the opening up of the higher education institutions to practical work, the old alma mater has again become attractive to major industry as well—instead of just hiring good people away from research and teaching, large conglomerates are now working together with the universities and colleges.

- IBM is developing new chips with Bonn University. The Stuttgart computer manufacturer has made DM 25 million available and has equipped the new university Institute for Discrete Mathematics with a large computer; in addition, they also assume part of the personnel costs.
- Siemens maintains close cooperation in computers with Duesseldorf University and in the field of software development with the Free University of Berlin.
- Schering and the Free University of Berlin are working jointly on the establishment of an Institute for Diagnostic Research.

The industry values its academic partners particularly when new advances in basic research promise great commercial success, such as for the new high-temperature superconductivity. In this context (see HIGHTECH 1/88) MAN Technology in Munich has joined with Munich physicist Prof James Shilling, and the Philips group enjoys the help of researchers from the Rhineland-Westphalian Technical College in Aachen and the University of Cologne.

In order to make the cooperation between theory and practice even closer, Prof Dieter Frey of the Christian-Albrecht University in Kiel recently proposed the introduction here of a regulation which has been successfully practiced in England: the combination of personnel at the higher education level and in industry.

According to Dieter Frey, half-positions should be created, so that a researcher could occupy one half-position in theory and one in practice, as professorial big shots in the research guild have already been doing for years.

### Finland's Wartsila in ESPRIT Program

*36980167a Helsinki HELSINGIN SANOMAT in Finnish 21 Mar 89 p 29*

[Text]Wartsila has been accepted as a participant in a European industrial R&D project, which is part of EC's ESPRIT program. The project that Wartsila's Marine group is participating in will be studying data processing utilization in the production control and guidance of individual production under demanding factory conditions.

The total budget for the project is about 20 million markkaa. The principle firm in the project is Bremer Vulkan AG, an FRG shipyard company.

Three other European shipyard companies are participating in the program. Another Finnish participant besides Wartsila is the Industrial Automation Institute of the Institute of Technology at Helsinki.

## SUPERCONDUCTIVITY

### European Superconductivity Program Outlined

*MI890127 Turin MEDIA DUEMILA in Italian Jan 89 p 107*

[Article by Tullio Regge and David Campbell; "Ninety Physicists Consulting on Superconductivity: ISI's Research Program."]

[Text] The program aims at selecting the one theory among all the others that might finally explain the fundamental causes of superconductivity—in other words, the rules governing the transformation of metals into exceptional media for conducting current without power dissipation. The ISI Foundation [Institute for Scientific Exchange] organized a meeting in Villa Gualino, where it is headquartered. The meeting, chaired by Tullio Regge, winner of the Einstein prize for physics, took stock of the theoretical research on superconductivity at high critical temperatures. The development of the program was financed by the EC, the National Research Council, and ENEA [National Agency for Nuclear and Alternative Energies].

Regge stated: "Superconductivity will make it possible to use, rather than waste, 30 percent of the energy running through traditional power lines, therefore saving an amount equal to the energy Italy is forced to import."

David Campbell, Director of the Center for Nonlinear Studies in Los Alamos as well as the ISI project on superconductivity, recalled that "this phenomenon was theoretically explained for the first time by Bardeen, Copper, and Schriefer in the late 1960's, and was consequently defined as the BCS theory. More than 50 years have passed since the Kamerling Onnes Laboratory in Leida (the Netherlands) first liquefied hydrogen and helium, thereby reaching a temperature of 273.14 degrees below zero. Last year, the Swiss scientists Alex Mueller and George Bednorz discovered a new class of ceramic materials based on copper, oxygen, and some rare-earth elements (yttrium and ytterbium) which become superconductive even at 90 degrees above absolute zero, that is, 183° below zero centigrade. This discovery earned them the Nobel prize for physics."

These "hot" superconductors use technology based on liquid nitrogen, a procedure which proves to be less demanding and less expensive than the earlier one based on liquid helium. Campbell, who did not lack a sense of humor, remarked: "There is the same price difference between nitrogen and helium as there is between whisky and lemonade—nitrogen is extremely abundant in the atmosphere, whereas helium is hard to find and supplies are running low."

Giuseppe Lanzavecchia of ENEA remarked: "In Japan, MITI is coordinating a program to subsidize companies operating in this sector. The United States is developing a national program on superconductivity: U.S. companies spend approximately $260 million per year on superconductivity research. With the exception of the ISI program, Italy lacks a true strategy."

### FRG, PRC Scientists Create New Superconductive Material

*36980158 Frankfurt/Main FRANKFURTER ALLGEMEINE in German 1 Feb 89 p N1*

[Article: "Superconductivity at Higher Temperatures"]

[Text] Scientists at the Juelich Nuclear Research Facility (KFA) have discovered a new compound which is superconductive at 130 degrees Kelvin (-143 degrees Celsius). The newly-created superconductor contains bismuth, lead, antimony, strontium, calcium, copper, and oxygen. Previously, transition temperatures of 125 degrees Kelvin had been reached with ceramic oxides free of rare earth elements. The new "mixture" was discovered by researchers from Hefei in the province of Anhui, PRC. KFA improved production within a few weeks, first raising the transition temperature from 100 degrees to 130 degrees Kelvin. At the same time, Chinese researchers claimed to have achieved a temperature of 165 degrees Kelvin. FRG researchers have already succeeded in producing thin films with the new superconductor, using another process developed at Juelich.

## TECHNOLOGY TRANSFER

### FRG-USSR Joint Venture Signed

*36980161 Munich SUEDDEUTSCHE ZEITUNG in German 28 Feb 89 p 36*

["N" report: "FRG-Soviet Machine-Tool Manufacturing Subsidiary"]

[Excerpt] Fuerth—The Soviet Union has created the conditions for a trade offensive. As of 1 April, every enterprise in the USSR is entitled to establish foreign

trade relations. This was announced by the deputy minister of the machine tool and tool-building industry, B.E. Kurakin, in Fuerth on the occasion of the signing of an agreement on the first FRG-USSR joint venture in the field of tool construction in Bavaria, the Hertel-Stanko GmbH company in Fuerth. Both partners possess 50 percent of the DM2 million capital. The minister emphasized that the Soviet Union is interested in expanding cooperation with German companies. The aim of the first joint venture is to intensify import and export activities, to enlarge the market for Soviet tools both in the FRG and in third countries, and to increase the sale of Hertel products in the USSR. [passage omitted]

## Two Finns Sentenced for Illegal Export of U.S. Computers to USSR

*36980157 Helsinki HELSINGIN SANOMAT in Finnish 17 Mar 89 p 3*

[Article by T. Arolainen: "Computer Exports Result in Long Sentences for Treason"]

[Text] On Thursday the Helsinki Court of Appeal gave a two-and-a-half-year prison sentence for treason to two businessmen from Helsinki. Their assistant, a man from Jarvenpaa, received a five-month suspended sentence.

In two years since the fall of 1985, the men illegally exported to the USSR large amounts of data communications technology and information of U.S. origin. They were also paid for the information they provided.

The businessmen violated the rules of the Western organization that prescribes export embargoes. Their crimes endangered Finland's future access to Western high technology, according to the officials.

Formally, the sentences were given according to the 7th section of the chapter on treason in the criminal law. The men were said to have disclosed information that should be kept secret in the interest of Finland, to have endangered Finland's relations with foreign countries.

### Two Get Long Sentences for Treason Because of Hi-Tech Exports

The Court of Appeal disclosed the indictment but declared the papers secret for 25 years.

The Helsinki Court of Appeal issued a two-year-ten-month prison sentence for treason to Peter Perovuo, export consultant, and Paavo Manner, engineer. Manner and Perovuo will have to pay back to the government the profits from their crimes, 180 000 and 100 000 markkaa, respectively.

It was made public on Thursday that a businessman from Jarvenpaa would receive a five-month suspended sentence for his assistance in the matter of treason, as well as for violating the so called emergency powers act.

The sentences were issued for continuous, deliberate and calculated crimes including "disclosing information that must be held secret from foreign powers in order to protect Finland's economic and scientific interests and external security" and "procuring for a foreign power information which may endanger Finland's relations with a foreign country."

From October 1985 to November 1987, Perovuo and Manner illegally exported information technology to the USSR and, in addition, were paid for procuring technology-related information to that country. It was determined that these actions had damaged Finland's interests and foreign relations.

The court decision is closely in keeping with the charges, of which the Court of Appeal rejected only one. The charges and the sentences were based on the same point of law, the 7th section of the chapter on treason in the criminal law.

Despite the long sentences, Perovuo and Manner were not ordered to be imprisoned. Since the defendants will appeal, their imprisonment and the length of the sentence will be ultimately decided by the Supreme Court.

For the first time, the decision defined the period of time during which the trial documents must remain secret. According to the Court of Appeal, the files can be made public after 25 years. In the past, the files of trials for treason have been declared secret "until further notice," and the decisions have not been changed.

### Information Technology to USSR

In its exceptionally extensive and open decision, the Court of Appeal did not make public the course of the trial, evidence, or the detailed grounds for the decision. However, the decision extensively reviewed the—up-until-now secret—information contained in the indictment.

On 14 occasions the men illegally exported from Finland foreign high technology, including both civilian and military devices and information related to them. They also got paid for delivering information on similar technology of foreign origin.

The devices had been brought to Finland on the condition that they would not be transferred to a third country without the permission of the authorities in the manufacturing country. Some of the devices would not have been granted an export licence, under any circumstances, to a country outside of COCOM, a Western organization which prescribes the export embargoes.

In the published documents there is no mention of either the manufacturing or the receiving country. However, during the entire trial it has been generally known that most of the devices were made in the United States and that the receiving country was the USSR.

Last April, the prosecutor had charged that as a result of the technology and information transfer the men had risked Finland's future access to high-level technology. The Court of Appeal concurred..

It was concluded that the disclosed information had endangered Finland's relations with the manufacturing countries and countries where the devices can be legally used. At the same time, information that should have been kept secret in order to protect Finland's economic, scientific, and military interests was disclosed.

**Customs Office Started Investigation of Exports**

In the course of the trial the defense lawyers tried to show that the illegal exports had not reduced access to foreign technology. Their assurances were not enough.

On the last day of October 1986, Perovuo and Manner, together with their assistant, exported from Finland a VAX-750 mainframe computer, which is the most significant of the illegally sold devices. The computer was exported to the USSR with a false license for an exhibit.

First, in a fake sale, Manner's firm sold the computer to the company of the businessman in Jarvenpaa in whose name it was transferred to the USSR.

In the opinion of the defense, the device was not intended for military purposes, as the officials classified it. In England there has been a trial concerning the export of a similar computer. The court has decided it was civilian technology.

In addition to the mainframe computer, 18 microcomputers, data generators, emitrons, mass storage stations for minicomputers, as well as a graphic work station, an oscilloscope, an amplifier contact unit, and a cable scanner were exported. The court did not accept the prosecution's charge that the export of four color graphic terminals was also illegal.

It was the export of the mainframe computer that got the authorities interested in the men's activities. The Customs Office began investigating exports in 1987, because it suspected that the men were violating the so called emergency powers act. In the summer of 1987, Perovuo and Manner were under arrest for a week and a half.

The Security Police and the Central Criminal Police, which later were in charge of the investigation, decided to arrest the men again a year ago in mid-March and to imprison them a week later. The men were imprisoned for three months.

The Court of Appeal trial began last April. The last hearing took place towards the end of last year. Altogether 21 witnesses were heard.

**COCOM Prescribes Export Embargoes**

The two businessmen exported in 1986 to the USSR an American, out-moded mainframe computer, which was written-off by an engineering company in Espoo. Over a year later, Rauma-Repola sold two deep-sea, high-tech submarines to the Soviet Union.

The businessmen were charged with treason on the basis of high-tech exports and illegal information gathering. Rauma-Repola was celebrated for opening new areas in the Finnish-Soviet trade.

Even Rauma Repola began to worry when two respected newspapers, the British INDEPENDENT and the French LE MONDE, accused in January of 1988 that the submarine sales violated the export embargoes on U.S. goods, which Finland had previously agreed to. The regulations were created by the Coordinating Committee for Multilateral Export Controls (COCOM), established in early 1950 to monitor exports of strategic products and technology.

Its members include Japan and the NATO countries with the exception of Iceland and Spain. The purpose of COCOM is to prevent high-technology transfers to the USSR and other socialist countries.

Finland is not a member of COCOM. A membership would be impossible according to the Paris peace treaty and the YYA [Friendship, Cooperation, and Mutual Assistance] treaty. On account of these Finland is committed to remain outside of any alliances directed against the USSR.

In spite of the official non-alignment, Finnish companies have dutyfully followed the controls set up mainly according to the directions from the U.S. Department of Commerce. Finland has been rewarded by a constant and free flow of high technology.

Recently, the review by the Industrialization Fund mentioned that Finland had joined COCOM. However, Finland as a state is not a member, according to the Ministry of Foreign Affairs.

Since last fall, Finland has been equated with NATO countries where access to technology is concerned. The latest example, a highly significant achievement in the field of computers, is a Cray supercomputer acquired by the State Computer Center.

The Confederation of Industries has for several years, upon request, provided Finnish companies with lists on embargoes—originally called U.S. Export Administration Regulations. The Confederation also discretely updates the lists.

In light of yesterday's sentences for treason, the regulations issued by outsiders can define the contents of the Finnish criminal law. In principle, the formally impeccable decision by the independent court can be interpreted as a clear warning: unconfirmed export embargoes must be obeyed, ultimately under threat of a life-sentence.

Adherence to the COCOM regulations will be like a tightrope act between Eastern and Western trade partners.

In foreign trade and economic relations Finland occupies two positions. This succeeds only by taking advantage of Western technology in production, the results of which will then be an important part of the Eastern trade.

A computer expert from England, Kevin Cahill, was the defense witness at the treason trial. His leading thought is that the COCOM was not founded to control East-West relations at all, but to keep a rein on the business activities of the Western competitors of the United States.

# COMPUTERS

## Hungary-FRG Cooperation in Production of ASKA Program System

*25020030 Budapest GEP in Hungarian*
*Dec 88 pp 465-467*

[Article by Dr Peter Gombkoto and Dr Gabor Horniak, of SZAMALK, and Dr Julius Kiss, of IKOSS: "SZAMALK-IKOSS Cooperation in Connection With The ASKA Finite Element Program System"]

[Excerpts] SZAMALK [Computer Technology Applications Enterprise] purchased the ASKA finite element program system from the IKOSS firm in Stuttgart. Installation of the 7.9 version of the system took place in November 1986. Installation continued during 1987 with the graphic pre-and post-processing systems. In this same year IKOSS put together the 8.5 version and, in 1988, a PC version of the graphic post-processing system. Advanced discussions are also taking place for distribution in Hungary of the VAX version of ASKA. In the article we provide a brief review of the results of SZAMALK-IKOSS cooperation and about the services recently available.

In the interest of introducing and spreading modern dimensioning procedures the Computer Technology Applications Enterprise purchased from the IKOSS firm in Stuttgart the ASKA finite element program system together with the associated ASKAMESH (FEMGEN) and ASKAVIEW (FEMVIEW) graphic pre- and postprocessing systems. The link between the two firms is not and will not be limited to a simple sale and purchase but rather with the transfer of new developmental achievements, with inclusion in ASKA developments and with the spread of a version of ASKA which can be operated on machines with VAX architecture a broad cooperation has developed which hopefully will continue to expand in the future.

### ASKA Version 8.5

With the first installation of the system in 1986 ASKA version 7.9 became available to users in Hungary. Although this version also makes possible use of a broad range of finite element services it reflects only the technical level of the end of the 1970's. Since there is also a need to solve heat conduction and transfer problems and since SZAMALK wanted to satisfy these needs it also purchased the ASKA HT (heat-transfer) module. This module is part of ASKA version 8.5 which was installed during 1987. Thus the modules available at SZAMALK are the following:

| | |
|---|---|
| ASKA I. | Linear-flexible statics module, the base module of the entire system. |
| ASKA II. | Linear dynamics module, for study of:<br>—natural values (natural frequencies),<br>—natural oscillations,<br>—excited oscillations,<br>—stochastic excitations,<br>—seismic simulations. |
| ASKA III-1. | Flexible plastic form change module. |
| ASKA III-2. | Flexible stability module. |
| ASKA HT. | Heat conduction module, to calculate:<br>—stationary and<br>—transient temperature fields. |

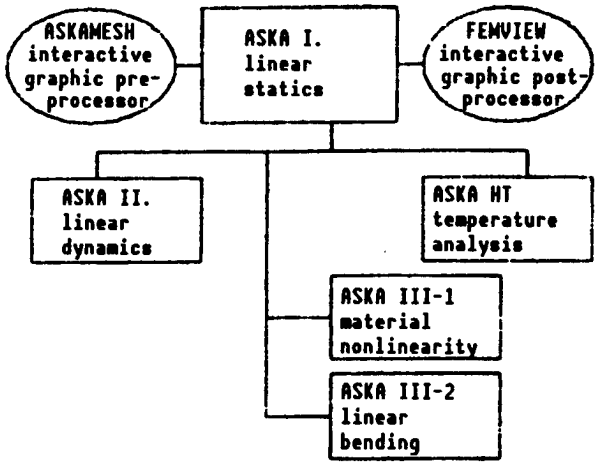


**Figure 1. Possibilities of a CAD/NC coupling Connection of System Components.**

The connection of the system components is shown in the accompanying figure.

In addition to inclusion of the HT module ASKA version 8.5 makes it possible to access the following extra services:

1. New elements: an 8 node disk element, a 3 node rod element, a general spring element and a layered 4 node thin shell element.

2. Improved elements: disk, volume and shell elements with improved properties (more precise stress computation).

3. MPC (multi-point-constraint) linking elements: to link elements with different properties (shell, beam, etc.) and different numbers of nodes.

4. Expanded loading possibilities: changing load along the line in the case of beam elements, general description of pressure and acceleration distributions.

5. Expanded testing possibilities: for sub-net and main-net link, balance study between active and reactive forces.

6. Expanded result calculations: determining stresses in the material main directions and stress maximums, calculating stress and bending conditions of shell elements, stress calculations in beam elements.

7. Reworked postprocessing: expanded and simplified interface files for connection to postprocessing systems.

**The PC Version of FEMVIEW**

The expanded and simplified interface files of ASKA 8.5 made possible a connection to postprocessing programs running on PC's. A PC version of FEMVIEW, earlier installed on an IBM 4341 mainframe, had been prepared and this was available to us from the beginning of 1988. With its aid the evaluation of results—shifts, stress levels, etc—and documentation of them could be done independent of the mainframe ASKA system, even separated from it in time and space.

The PC version of FEMVIEW can run on IBM AT compatible machines having color EGA graphics. [Paragraph omitted.] In figures 1-8 [not reproduced] one can see pictures of a complex, milled part in various work phases.

The new switching elements of the 8.5 version also make possible a study of shells stiffened with beam elements.

**ASKA Distribution Contract**

It may be advantageous for users regularly needing the possibilities of finite element analysis if they have their own system. To satisfy these needs the IKOSS and SZAMALK have jointly prepared a draft contract according to which SZAMALK will get the Hungarian distribution rights for a version of ASKA which can run on VAX and VAX architecture machines. The contract is practically ready to sign.

Choice of the VAX version is justified by the fact that a significant part of CAD software runs on VAX compatible machines as a result of which these machines are fairly widespread in Hungary as well. SZAMALK will also undertake, in case of need, to ship ASKA together with the MIKROSZTAR-32 computer.

**Further ASKA Developments**

At the moment the IKOSS firm already sells the 8.6 version of ASKA and is working on a 9.0 version. SZAMALK also has joined in the development so it is following it and we will be able to offer Hungarian users the new phases of development.

## Hungarian Cooperative Producing, Exporting Chemical, Pharmaceutical Software

*25020029b Budapest*
*COMPUTERWORLD/SZAMITASTECHNIKA*
*in Hungarian 28 Dec 88 p 2*

[Text] Leaders of the CompuDrug Technical Development Small Cooperative gave a press conference in a special hall of the Olympia Hotel to report on their business successes since the firm was established 5 years ago and to show their newest products.

At present, with 40-50 people, they realize sales receipts of 110-120 million forints per year on the domestic market and in addition they export their products to 22 countries. Their chemical-pharmaceutical designing software is especially sought after on the foreign market although here at home—unfortunately—there is little solvent demand for it.

At the exhibit journalists could see the newest version of the EkSzer text editing system which can display text on electronic typewriters and laser printers in addition to traditional printers.

The leaders of the firm announced that in order to expand office use of computer technology the small cooperative was developing a new program system which can be used at any work site, and EkSzer will be part of it.

Their other two new items may be of interest to organizations using computer technology or regularly participating at exhibits and fairs.

The Video-Safe is an insert made to the standard dimensions of video cassettes and supplied with security lock and conducting-fastening elements. Its use prevents unauthorized use of a video cassette player without locking it up or altering it, and the cassette cannot be stolen. Its retail price is 799 forints.

The MON-X 345 protective eyeglasses are made primarily for workers sitting in front of computer screens but they can also be used in other areas under lighting conditions deviating from the average (e.g., by drivers to reduce reflection glare or to amplify weak color contrasts).

## Environmental Protection Software Developed by Hungary

*25020029a Budapest*
*COMPUTERWORLD/SZAMITASTECHNIKA*
*in Hungarian 28 Dec 88 p 2*

[Text] The Microsystem Small Cooperative recently marketed a personal computer program package to aid environmental protection. The software, developed in cooperation with two faculties of the Budapest Technical University, supports use of the so-called traffic diagrams method. With mathematical modeling of technological

processes (for example, the amount of scrap as a probability variable) one can determine values and their distributions for energies and materials to be used and to be produced as by-products and can calculate and depict the cost content of waste. One can compare and analyze two or more technological processes according to various viewpoints—material yield, energy use, economicalness, etc. With this tool one can develop technologies producing little waste.

The prescriptions of a Council of Ministers decree pertaining to monitoring of the production of dangerous wastes and to rendering them harmless was "built into" the software. The first users of the program package are the Ministry of Environmental Protection and Water Management and the EGIS Pharmaceutical Factory.

## GDR: Software Development Using FORTH System

*23020036 East Berlin MIKROPROZESSORTECHNIK in German No 11, 1988 p 333*

[Article by Lubomir Karadshow, Karsten Noack, Michael Wychofsky of VEB "7 October" Machine Tool Combine, Product Development Division: "Software Development with FORTH"]

[Text] Developments in microcomputer technology are currently characterized by an explosion in hardware power. The price-output ratio of available systems is continually improving. Consequently, it is expected that the number of computer installations will increase sharply in the years ahead, and that significant areas of application for computer technology have yet to be opened up. These factors are an indication of problems that remain to be solved in software technology. Conventional programming systems will prove to be inadequate. In general, existing means for systems development are considered company know-how and are thus scarcely accessible, as well as being insufficiently flexible in many cases.[1]

Development modules based on FORTH methodology represent one possibility for solving these problems. Unlike with standard programming resources, this is a completely open system that from the very outset is realized in the language that it displays. The fact that the entire system source is available in FORTH for program development is unique. Every individual system-internal routine is accessible and can be analyzed, modified and reused for various purposes. The conceptually supported access to the entire system results in characteristics that are unique. One example is the possibility of altering the function of existing language elements, thus modifying finished programs without repetitive development work (editing, compiling) or dynamically changing program sequences during execution.

The most striking external features of the new program development philosophy embodied by FORTH are the extreme ease with which all language and system elements are used, as well as the organic unity of the system core and the expanded applications. The latter means that the main components of the system (interpreter, compiler, editor, debugger) are expandable or modifiable in a user-specific manner, so that applications and systems with completely different properties and language elements can be developed.

Simple programming with self-defined language elements and the uncomplicated use of a unified development system make it possible to engage in a simple dialogue with complicated hardware, and decrease the time spent on testing and experimenting during programming.

After the end of the test phase, complete FORTH programs can be put into a final (optimal) version using metacompilation, which is regeneration of a FORTH system through self-compilation.[2] Using a so-called metacompiler, FORTH core systems can be generated for other microprocessors and operating systems, systems with modified properties and optimized final compilations of programs. FORTH-oriented systems are particular effective for the development of:

- Compilers/interpreters for special and technical languages
- Programs for computer architectures for which there are no special program development systems available
- Programs for small computer systems (especially single-chip microcomputers)
- Field-specific program development systems (programming of machine controls)
- High-performance controls on the basis of FORTH processors (several million FORTH operations per second)
- Intelligent translation systems, by linking artificial intelligence modules in the metacompilation process

In recent years, we have observed very broad areas of application for FORTH. In particular, its use in image processing and in automation technology has increased. Parallel to this is a growing need for program development systems and productive programming environments that can do justice to the growing size and increasing complexity of the problems to be solved. One particularly productive program development system has been developed with regard to plans for ongoing work on programming controls using modern software technologies (computer-aided translation/code generation) at the Scientific-Technical Center of VEB "7 October" machine tool combine, Berlin (NILES), based on results from the Technical College of Ilmenau (TBK, WB Computer Technology).[2,3] The system is FORTH-83 compatible and primarily designed for 16-bit microcomputer systems. Its organization is modular, and it has at its disposal a large number of expansion modules that

can be used in applications, as well as a very comfortable editor, a metacompiler and numerous testing and service programs. There are versions for the most common 8- and 16-bit microcomputers (see also Boerse).

FORTH is proving more and more to be a powerful and at the same time very effective "intermediate language" for hardware-bound and hardware-specific programming. At the same time, FORTH is a technical language for use in constructing any technical languages characterized by object and process proximity, as is typical for the highly branched area of microprocessor equipment technology and embedded microprocessor computers.

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## GDR's IMAGE-C Processing System Described

*23020040 East Berlin RECHENTECHNIK-DATENVERARBEITUNG No 11, 1988 p 42*

[Text] Based upon experience gained from the application of the A6471 image processing system, the IMAGE-C system came forth as an automated, digital image processing system of greater flexibility, versatility and economy. IMAGE-C is an image processing software package written in the C programming language. Apart from the basic software package with routines for image manipulation and image processing, the IMAGE-C system's level of innovation is marked, above all, by the fact that it offers the user a menu system for working through processing functions without separate programming. The user is also offered an interpreter for the dialogue-oriented construction of image processing algorithms.

The standard software libraries of the C programming system for program processing and program testing were integrated into the system.

The respective field of applications is concentrated around microscopic image analysis. Moreover, IMAGE-C can also be used for the interpretation of macroscopic and remote sensing images. On the basis of its flexibility, IMAGE-C can be adapted to the most diverse problems. Particularly worthy of emphasis is the availability of an expert system for identification and classification of object populations.

The system is based upon the EC 1834 16-bit PC with a 640 Kbyte main memory capacity, one 720 Kbyte floppy disk and a 20 Mbyte fixed disk, in conjunction with the K 7067.15 image processing unit (768 x 512 x 8 bit mapped memory).

Image input is effected via the video input of the image processing unit. Image output is carried out via the color monitor and the graphics printer. The software package is highly portable so that it can be rendered compatible to other hardware systems, if need be.

## 'Teachware' Displayed at Dresden Software Exposition

*23020041 RECHENTECHNIK-DATENVERARBEITUNG in German No 1, 1989 p 2*

[Article: "Teachware on Display At Dresden Software Exposition"]

[Text] At a recent software exposition held in Dresden, East Germany's VEB ROBOTRON exhibited several software packages offering potential users a self-study capability. More and more, these software packages (called teachware) are becoming an alternative to expensive training involving the large-scale application of office, personal and work station computers. The teachware diskettes were demonstrated in actual system configurations, with the aid of an EC 1834 personal computer and an A 7150 work station computer. The diskettes were made available for purchase or could be ordered.

Among the teachware packages offered by ROBOTRON were the following:

- BASIC teachware (8-bit SCP) for BC 5120/BC 5130 and PC 1715 machines;
- BASIC teachware (16-bit SCP) for the A 7100 and A 7150 systems;
- REDABAS teachware (8-bit SCP) for the BC 5120/BC 5130 and PC 1715 machines;
- DCP teachware (REDABAS-3 for database/operating system and TPLERN for text processing) geared to the EC 1834 and A 7150 computers, and
- Computational programs (8-bit SCP) for the BC 5120/BC 5130 and PC 1715 machines.

A prototype of the DCP teachware DCPLERN (DCP operating system and service programs) was also on display. It was announced earlier that this software package would first become available by mid-December 1988. The same holds for the MULTICALC tabular computation program for the EC 1834 and A 7150 computers.

## GDR's 'PROCAD 16' CAD/CAM Software Package Described

*23020025 East Berlin RECHENTECHNIK DATENVERARBEITUNG in German No 10, 1988 pp 5-8*

[Article by Peter Bube, Joerg Sandig, VEB Management Center for Applications Research, Software Enterprise CAD-/CAM, Enterprise of the VE Combine Data Processing]

[Text] With the PROCAD 16 mechanics/CAD system the VEB Management Center for Applications Research—Software Enterprise CAD/CAM—provides a 16-bit version of the PROCAD software package.

Among its essential components are the following:
—2-space design system
—parametric system
—PROCAD's own programming language
—user interface (merging of FORTRAN programs)
—PROCAD administrator functions.

With the aid of the PROCAD 16 CAD system design problems in 2-space can be efficiently solved using the various system components. In particular, the design process can be substantially shortened and automation of certain partial processes can be implemented by working out one's own drafting or calculation programs.

Besides the working out of one's own programs, the parametric system represents an essential factor for the effective employment of the CAD system. Based on the one-time-generation of a prototype drawing using the 2-space drafting system, various variants can be generated and incorporated into any designs to be drawn up.

By means of the various configurational and adaptational possibilities (PROCAD administrator), the PROCAD 16 CAD system may be employed in the most varied areas of machine construction and electrical engineering.

In addition to the aforementioned standard system components, other supplementary components are made available, among them the electrical engineering project (in preparation) and building blocks for the CAD-NC interface connection implemented on the basis of the user interface (FORTRAN). For providing an interface between 32-bit and 16-bit computers, computer communication software is being produced, permitting the mutual interchange of graphics files or other ASCII data files and making possible their further use on the other computer.

### Scope of Performance

Standard System Components

#### —2-space Design System

The starting point for work with the PROCAD CAD system is the two-dimensional graphic design system. The principal philosophy of this system thus stems from the designer's customary approach to any design. After drawing in a screen border, in conformity with [existing] technical standards, material specifications and delivery conditions or subject to any other restriction, the designer can produce his drawing on the CRT by interacting with the CAD system. The PROCAD CAD system provides numerous aids for interactive graphics operations on a CRT. These include:
—enlargement of graphics segments with free choice of the screen corners lying on the diagonal or enlargement and reduction of the area around the cross-hairs
—coordinate data can be either free or unknown points (the position of the cross-hairs at any given time is used as a free point. Unknown points relate to the geometry in the vicinity of the cross-hairs, such as a point on a line, a point of tangency, 2 points on a plumb line or 2 points of intersection of lines).
—coordinate transfer by digitization of a pattern (with orthogonality correction)
—construction of circles and arcs, the fairing in of rounded contours (additional), ellipses, parabolas
—construction of tangents, a point on circle or on two circles
—curve approximation, in which any number of points is approximated by a polymonial
—the determination of imaging precision for circles, ellipses, parabolas, and splines on the CRT (polygon course)
—semiautomatic dimensioning, i.e. fixing of the position is required
—dimensioning of the most varied forms and formats
—automatic crosshatching with selection of the crosshatching format (angle, interval)
—special crosshatching, such as the blacking out an area or patterning it with free-form linear shapes
—availability of the broadest diversity of linear shapes
—availability of special lines, such as pipelines with specifications of width, a welding line or rail line on a map
—additional changes (editing) of the lines drawn
—analysis of graphic elements on an alphanumeric display
—manipulation of drawn elements by means of predetermined factors for division, doubling, or halving
—availability of design guidelines of the most diverse shapes, which assume the role of the pencil guidelines in the design process.
—availability of a network of guidelines exhibiting either an active or passive function
—a configuration of planes with a maximum of 1024 planes
—definition of logical units
—selection of segments of a graphic design by enclosing them within group lines, irrespective of the planes in which the elements are located
—manipulation of these elements (displacement, enlargement, reduction, rotation and reflection)
—uploading of these elements for utilization in other designs is possible (partial designs)
—loading of these elements with simultaneous manipulation

—availability of MACRO technology, i.e. any command sequences may be combined, filed, and executed
—MONITOR protocol function (files commands used in a file which can be retrieved and edited).

The aids cited in this brief description represent but a small part of the possibilities of the CAD system PROCAD, but they should suffice for an overview:

**—The Parametric System**

In order to produce a design variant, one needs to begin from a prototype drawing, altering certain dimensions and magnitudes for the purpose of deducing additional, in principle, identical drawings.

The CAD system PROCAD offers a very convenient approach for this purpose in that a new drawing, reflecting the changes made, is produced on-screen by writing over the dimensions in the [original] drawing. A prerequisite for the automatic parameterization is an exact, complete dimensioning of the component. However, the dimensioning does not necessarily have to consist of numerical values, but can be replaced by any algebraic expressions or variables.

The parametric system calculates the required values from the expressions and applicable variables and uses them for constructing the new drawing. Another component of this system permits the down-loading of previously drawn components for use in the current drawing parameterizing them during the down-loading process.

Here, the arrangement of the current dimensions is effected by calling up a line from a previously defined dimension table or by means of optional interactive input.

This procedure makes it possible, for instance, to setup standard part inventories or operational standards in a relatively simple and rapid manner.

Aside from this fundamental application of the system, it is also possible, to simulate motion and to study lever-equipped gearing units.

**—PROCL User Language**

The scope of performance of this language is approximately that of the programming language BASIC.

It permits the writing of simple programs which may be included in the on-screen design process in order to automate certain continually recurrent operations.

Aside from the PROCL language elements, all PROCAD commands can be incorporated into the program.

The programs created can be stored in files, may be retrieved at any time during the design process and can be coupled with menu functions.

**—User Interface**

For sophisticated approaches an interface is available for integrating separate FORTRAN programs—and for working through them. The interface provides a library of FORTRAN routines making it possible to read from the "graphics page" as well ask providing a rewrite capacity. This component is suitable, for instance, for the integration of control computing systems, whose results directly affect the design. This interface is also suitable for transferring data to CAD or evaluation systems connected downstream.

**—System Configuration**

One important advantage of this system is that it can be configured according to the wishes of the user and to specific operating conditions. The user himself decides on the composition of the system, the number and format of the menus used, and the type and shape of the graphic elements.

(1) definition of the graphic elements

Deviating from the standard definition, additional graphic elements can be defined in tabular form without any programming know-how.

For this purpose, it is necessary to have data pertaining to the name of the element, the definition of the level and the graphic representation.

(2) definition of the menus

By defining a matrix of arbitrary size, individual commands or sequences may be assigned to each field.

Since the definition is given again in simpler tabular form, modification or redesign is extremely uncomplicated.

The matrix definitions are translated by a special compiler and subsequently assigned to a desired position in the digitization table. The assignment can be repeated and renewed as often as desired.

(3) definition of the user system

With the definition of the components to be included in the user system, the user decides the scope and size of his system.

Depending upon operational and application-specific conditions, only those components are to be integrated, which are necessary for the solution of the problems at hand.

At the same time, the selection contributes to the efficiency of the system.

By developing and incorporating separate components, the user system can be redefined without any problem.

(4) plotter utilization

In addition to providing functional plotter software for selected models, the integration of additional plotters can be accomplished quickly and without any problems by providing prefabricated software.

**Components for CAD/NC Coupling**
—Possibilities of a CAD/NC coupling

In order to guarantee data flow throughput and to increase efficiency, CAD/CAM systems are being continually upgraded with components for CAD/NC coupling.

In a CAD/NC coupling, geometrical and other component data, available in the data base as a result of the computer-assisted design process, are used for NC programming.

The geometrical description of the elements to be manufactured can hereby be dispensed with by the NC programmer.

This can lead to considerable savings, since this process is expensive and frequently encumbered with defects, particularly for complicated parts.

Two coupling modules exist for PROCAD 16, which permit the three customary coupling variants (fig. 1).

The modules are integrated into the CAD system and thus constitute an expansion of the CAD system.

Model 3 of module 1 (AUTOTECH module) generates, as an output based on the PROCAD symbol table, a complete parts inventory for the NC processors AUTOTECH-NCM and AUTOTECH-BOFR32.

In keeping with production technology viewpoints, the PROCAD symbol table is to be prepared beforehand using graphic interactions and the CAD system.

Already generated parts inventories or macros can be used again and again.

If needed, the data transfer to the NC system can be limited to the transfer of geometric [data].

Technological information can then be supplemented as previously. However, for handling the geometrical data, graphical verification and interactive processing are required.

Module 2 (ISO module) permits a CAD/NC coupling corresponding to models 1 and 2 (fig. 1). In the module two output channels provide the two paths.

Model 2 of the module generates the standardized CLDATA interface (DIN 66215) which serves as an input for the NC postprocessors.

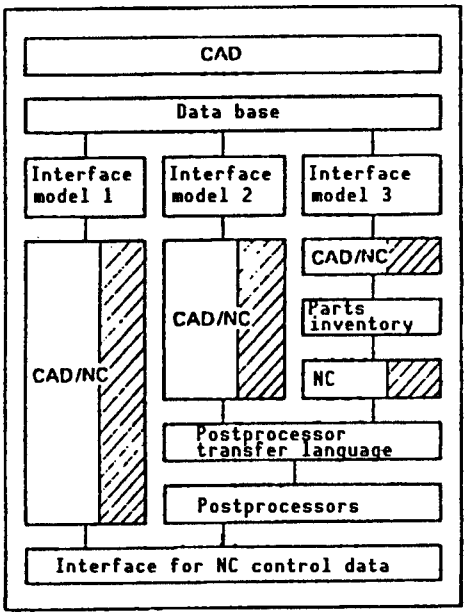


**Figure 1. Possibilities of a CAD/NC coupling.**

This coupling variant therefore remains computer-independent, since the specific peculiarities of a numerically controlled machine tool are fixed in the respective postprocessor.

In model 1, NC control commands are directly transmitted over the second output channel, pursuant to ISO 6983/1-1982, TGL 200-0863.

In contrast to the previously described coupling methods, in this case the increasing capacity of the CNC controls is better utilized.

Technological approaches problems such as cut segmentation are handled automatically in the control units via cyclic commands, so that this function becomes redundant in the NC processor, especially since the latter transmits individual commands to the control unit leading to unnecessarily long control programs.

The machine-specific adaptation takes place using generalized postprocessors.

Using this software tool, the cost of adaptation, prompted by the standardization process for NC control formats, is essentially less than for conventional postprocessor development.

**—Procedure for CAD/NC Coupling**

The principal operating methods for both NC coupling modules for PROCAD 16 are similar.

The respective peculiarities come to the forefront at the proper place. The software supports the preparation for production in the following processes:

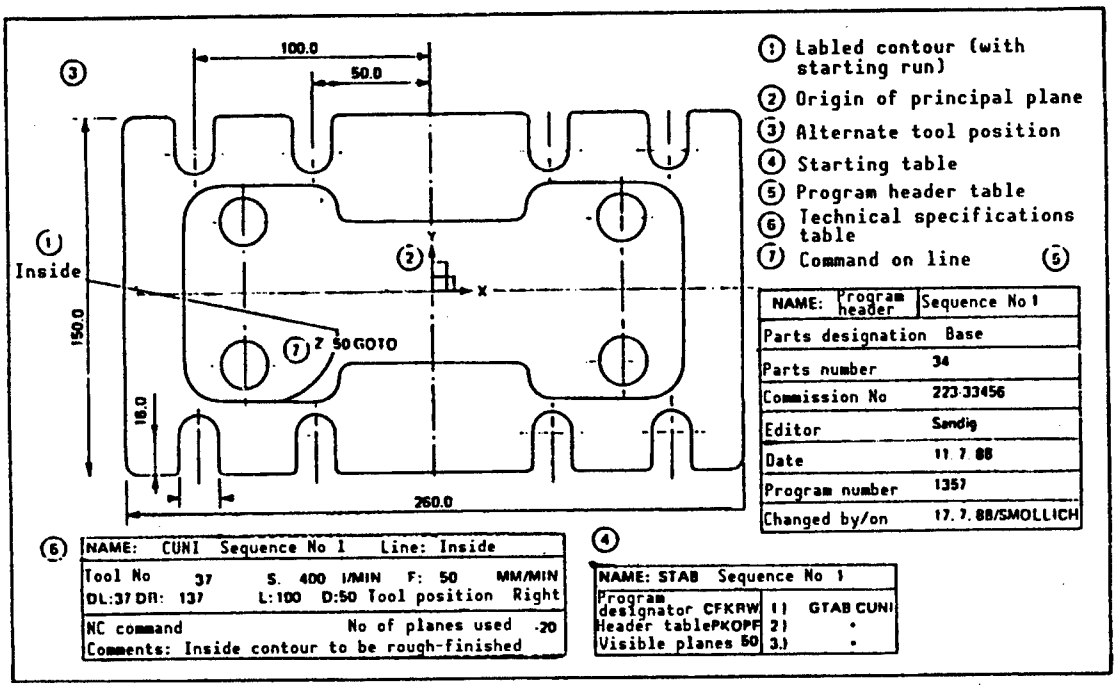


**Figure 2. Production technology design drawings for ISO module 2-1/2D milling)**

—Drilling/milling (2-1/2D)
—Turning (in preparation)
—Eroding
—Sheet metal working (nibbling, flame cutting, and similar processes).

The starting point for the CAD/NC coupling is the PROCAD symbols table prepared by the design engineer. In an initial problem configuration, the geometric generation of the design is carried out from the standpoint of production technology.

For that, the NC programmer has to perform the following operations (Figure 2):
—activate the contour
—check the arrangement of the contour elements (change the orientation, if required)
—prepare auxiliary geometries
—remove the label (name) from the starting point. Texts and source languages may also be labeled.

The position of the elements is thereby processed.

Additional tasks are the establishment of the coordinate system for the workpiece, fixing the alternate tool position, and the determination of the starting runs.

The technological data are integrated into the table from tables filed as symbols.

They contain a description of the tool, its operational parameters, the name of the table, and additional information.

The tables are connected with the line by way of the name.

Commands can be transmitted over the lines which in turn call up lines and tables.

Additional tables can be called up from tables in the ISO [International Standards Organization] module.

Tables with the same name can be combined by sequence number.

A flexible structuring or processing sequences thus becomes possible.

The tables can be filled by means of alphanumeric dialog or graphical interaction.

The NCM module offers the user a single table for each production process.

The ISO module contains software tools for any desired table layout, making it possible to take operation-specific peculiarities into account.

Both of the modules permit the processing of macros.

Integration is carried out by means of commands entered in the tables (only the ISO module) or composed on-line.

All operational steps require that the NC programmer have PROCAD know-how, as taught in the 2-space basic course.

After conclusion of the production engineering phase of the design (Figure 2), the CAD/NC coupling module is activated, generating NC data from it, depending on the coupling procedure.

It is also possible to process several PROCAD symbol tables in a single program run.

The applications-specific configuration of the system is supported in many different ways, thus providing a high degree of flexibility:

(1) ISO module
—syntax table for NC commands (expandable by means of its own commands)
—generator program for data tables, for error determination and warnings
—assignment of PROCAD element types to processor functions
—mask generators for technological tables, as well as NC formats
—integration of user program

(2) AUTOTECH module
—allocation of types of PROCAD elements to processor functions by way of configuration data files
—integration of separate NC commands (without syntax control).

**Operation of System**

Two possibilities are offered for the operation of the PROCAD graphic system.

Commands are input either with a standard alphanumeric keyboard or via the menus already cited, which must be positioned on a digitizing platen whose fields are touched by a light pen or magnifier. The menus are drawings containing texts or general characters in framed fields, indicating their respective functions.

They can be used either as single menu or a book menu which can be "leafed through" by selecting the menu number.

This method was selected in order to keep the graphic screen free of menu functions and to make the total screen area available for design purposes.

The input commands are logged on an alphanumeric screen which is required in addition to the CRT and, if need be, are commented upon by means of error messages.

Graphic interaction (e.g. identification, manipulation of geometric objects on the screen, removal of texts...) is performed by means of a light cross positioned by a mouse.

In addition to this possibility, the coordinates can also be input directly via the keyboard as absolute coordinates of displacements of the last point.

A third variant of the coordinate transfer is the digitization of an existing drawing on the digitization platen. Based on the operating system used, several processes can be run simultaneously. Thus, apart from the actual interactive work with the PROCAD 16 system, it is possible to operate the plotter program in other processes, to transfer batches of data between 16- and 32-bit computers as well as to carry out file work.

**Hardware Prerequisites, Operation System**
—16 bit computer (EC 1835-compatible)
—hard disk 30 megabytes
—expansion of main memory - 2 megabytes
—serial interface expansion
—external graphic controller
—high-resolution graphic screen
—digitization platen
—mouse
—UNIX compatible PC operating system.

Beginning in December 1988, an approach to replacing the controller with a high-resolution graphic card will be provided.

In collaboration with the VEB (state-owned enterprise) Accounting Machines, Karl-Marx-Stadt, PROCAD 16 will be made available for the EC 1835.

**Standard Parts Inventories**

The approach for inventories of standard parts, available in the PROCAD 16 graphics package, uses the parametric concept, which is system-specific and can't be applied to other CAD systems as yet.

Owing to the necessity for providing a description of standard parts and standards independent of the computer and program system, the VEB Management Center for Applications Research has begun development of an independent system in collaboration with the VEB Metal Forming Technology, Erfurt, the ASMW [Office for Standardization, [Measurement, and Product Testing], and the Institute for Information and Computer Science of the Academy of Sciences. With the availability of these components, the standard parts inventories for PROCAD 16 are being provided.

**Computer Coupling**

Because of the different types of computers available, the exchange of data becomes a matter of necessity.

By providing the corresponding communication software one assures that graphic designs or component parts can be freely exchanged. Apart from making possible the exchange of graphics and data, the coupling of a 16-bit and 32-bit computer permits the use of the 16-bit computer as a preliminary work station for three-dimensional modeling. After generating the input designs required for the 3D modeling process, the graphics file can be transferred to the 32-bit computer and the modelling can be performed. The visualized pictures can subsequently be called up at a PC, displayed, and if required, manipulated again according to the PROCAD philosophy.

## GDR: Personal Computer CAD/CAM Software Described

*23020026 East Berlin RECHENTECHNIK-DATENVERARBEITUNG in German No 10, 1988 pp 12-14*

[Article by Gudrun Krueger, VEB Control Center for Applied Research, CAD/CAM Software Operations, State-Owned Combine for Data Processing: "PCCAD—Computer-Aided Design"; first paragraph is introduction]

[Text] The PCCAD program is a two-dimensional CAD system that is being completed as joint development project between the VEB Robotron Accounting Machine Work, Karl-Marx-Stadt, and the VEB Control Center for Applied Research for EC 1834 and A 7150.

### Area of Application

The system is modular in configuration. The basic package, which is itself powerful, can be expanded through various sector-specific modules. These modules support the design work typical of various occupational groups, and make possible faster designing and drawing. At present, the following sector-oriented modules are available, in addition to the basic package:

— Mechanical engineering, PCCAD/M
— Electrotechnology and electronics, PCCAD/E
— Architecture, PCCAD/A.

The modules for mechanical engineering in particular have wide applications, but in conjunction with the basic package and the variation language, they offer effective design options.

This system for computer-aided design can essentially be used in any design office, where a clear improvement in efficiency can be achieved in a very short time. There is no question that drawing with PCCAD is considerably faster than in the conventional fashion, after for a certain familiarization period. Changes in existing drawings can be executed quickly. Data is stored on diskette, and takes up little room.

Basic functions of design, such as connecting points, setting tangents on circles and drawing the bisecting line of an angle, are executed exactly. The depictions of the corresponding drawings are mathematically precise. In principle, PCCAD can output its drawings to all plotters from A4 to A0. Many plotters are already made with a separate driver routine. The user can adapt other plotters in a short amount of time and without programming knowledge.

### Functional Description

The PCCAD program is a dialogue program. It asks the user questions or offers him selections in the form of a table (menu), and receives the user's response. For this dialogue, PCCAD uses two different modes, depending on the type of question—alpha mode and graphics mode.

In alpha mode, the dialogue (PCCAD messages and user keyboard input) takes place by way of the alphanumeric display screen. Graphics mode operates exclusively by way of the graphics screen and, depending on the function selected, allows both keyboard and digitizer input. The menu is clearly visible at one edge of the screen. It offers a number of options, from which the user must select one. After choosing an option, the program offers either a submenu or goes into cursor mode. The screen now displays the possible menu subcommands, so that the user is not confused by too many options. Once the program goes into cursor mode, a cross hair figure appears on the screen. The cross hair follows the movements of the pen/lens on the digitizer board. In this way, points, line segments and arcs are drawn, and parts of drawings or entire drawings are manipulated.

### Status Information

In the lower part of the menu column are status indicators that provide the user with information about the level on which he is currently drawing, the type of line that he has selected for segments and circles, the coordinate location of the cursor and the amount of free main memory still available. In addition, the length and direction of vectors can be indicated while designing. In order to increase processing speed, these status indicators or parts thereof can be faded out. The display function is particular attractive. Using this function, all the graphic information used for the drawing can be called in. After entering a line segment, for example, the beginning and end coordinates, angle, length, etc. are displayed. The display shown in the status block can be varied interactively by the user at any time.

### Image Size

The image size (dimensions of the drawing to be produced) is the original size, i.e., the dimensions that a rear projection of the image would have to have in reality, not the dimensions of an imaginary drawing page. All information on dimensions is based on the actual size of the part that is being designed. While designing on the

display screen, no conversion to the proper scale is necessary. This is done at the startup of output (plotting) by inputting the desired scale factor.

### Levels

In order to facilitate handling the large number of picture elements/symbols and structure drawings logically and functionally, there is the option of "filing" them in various "compartments." The term "levels" has been chosen to describe these compartments in PCCAD. Structuring an image into levels can be concretely compared to drawing on layers of transparent film. There is a maximum of 128 levels available, any number of which can be displayed on the screen at the same time. While designing, the user decides which level he wants to draw on. He can copy parts of a drawing from one level, erase entire levels with a command, store individual levels, and so on. The drawing elements used in PCCAD consist of basic geometric symbols: point, line, circle, arc and text. For lines, circles and arcs, the type of line, the color and/or the line width can be defined individually or for an entire level.

### Symbols

Besides the basic symbols, there are symbols automatically composed by PCCAD, such as squares and polygons, a collection of individual elements later defined as a sequence by the user, and symbols composed by the user. The use of these symbols by PCCAD means a large savings in time spent on formulating all types of drawings. The user composes the symbols typically used in his field and stores them in a symbol library under an appropriate key word. From there, they can be called in at any time and used as often as he wants, at any scale and in any position in the drawing. Several symbols, and even entire drawings can be abbreviated as a single symbol, thus helping to increase design and drawing speed. In practice, dozens of symbols are soon available in the symbol library. In order to use every symbol quickly and directly, each user can store his most common symbols in a matrix of 100 "cells." This matrix can be plotted out by the user and stored on the digitizer board. From there, the desired symbol is called in optically and positioned in the drawing at the desired place. Simply by designating drawing elements with the cross hair, a sequence is defined or identified. This sequence is then treated as a symbol, meaning that it can be copied, moved, turned, mirrored or deleted as a unit. The individual drawing elements can be positioned on different layers. This combination of layers is also preserved after manipulation.

### Design Aids

Mathematic-geometric help functions facilitate work and make it possible to work effectively. These functions include the option of superimposing a grid of picture elements over the drawing field. The x- and y-interval of this grid is freely definable. The grid ensures that while drawing points or line segments, the beginning or end point can be defined quickly and precisely with the cursor. The cursor jumps automatically to the next grid element, thus providing an exact link to an already defined point. This grid network can be transposed or rotated by any angle, so that a particular point in the design drawing is positioned at a grid element. Using a radial angle grid, the user can specify that he wants to permit only lines in a certain direction. This can mean a faster design and drawing phase. Furthermore, PCCAD features an entire range of designs aids that generate auxiliary lines for further design steps. These design aids include the mean perpendicular, the bisecting line of an angle, parallels, tangents, perpendicular, horizontal or vertical lines through a point, and so on. Particularly helpful in PCCAD is three-table projection. Using projection lines, and starting with an already-designed top view (horizontal projection), the other views (lateral and front view) can be drawn up quickly. All auxiliary lines are drawn on a specially defined level, and can thus be deleted with a single command once the design phase is completed.

### Point Design

While designing, the user can define the points either optically with the cursor or using numerous point design options. To this end, PCCAD offers a wide selection of options, from relative and absolute coordinates, the intersecting point of two straight lines, two arcs or of an arc with a straight line, or the division of a straight line into a given ratio, to finding the center of a given circle or arc, to determining the end points of a line or arc and finding the reference point of symbols and texts. After calling in the desired form of point design, PCCAD provides assistance in executing the individual steps of this design. It is important for the user here that he does not have to position the displayed cross hair exactly on the intended design point, only in its general vicinity; PCCAD determines the right point automatically. Line segments can be designed by way of polar coordinates, whereby based on a defined starting point the direction and length of the vector is entered numerically. This is primarily of importance when an exact line must be laid off a ray. With the same degree of precision, the initial and end angle of a circle or the radius can be determined. The (auxiliary) intersecting points generated in this way can be joined using polygon design.

### Manipulation Options

Many drawings, especially symbols, must be manipulated frequently. This includes rotating by a certain angle, enlarging/reducing by a certain factor, copying-/transposing into another level or to a different position on the same level, mirroring around a defined axis and deleting individual drawing elements, entire levels or the entire drawing. Naturally, all of these functions are available in PCCAD.

### Details

In order to process individual features of a drawing, any detail can be enlarged. This detail, delimited by a square or defined by a factor, is depicted in the entire picture area. It is also possible to depict a detail of a detail. In order to be able to call in and manipulate these details more quickly later on, they can be numbered.

### Dimensioning

All the drawing elements can be dimensioned. Dimensioning is semi-automatic. For lines and radii, the original scale of the drawing is always used as a reference. The user can freely define the number of significant figures for lines and angles separately. Lines and angles can be dimensioned either individually or in chains, or referred to a common point (reference point dimensioning). Radius and diameter arrows are alternately placed and labeled inside or outside the circle or arc.

### Labeling

To provide flexibility in labeling drawings, there are numerous text configuration options available. For example, letter height, width and interval can be freely defined. Text can be inserted in any angle or along any straight line, and can be written or shifted so as to be multiline, flush left, flush right or centered. It can be enclosed or fit into defined limits. In the event of subsequent labeling, the old text sizes can be determined from the keyboard and, if necessary, automatically reused for further labeling.

### Surfaces

PCCAD has options for shading closed surfaces at any angles and any interval. Similarly, closed surfaces can be filled in. The shading process is properly executed here even if other objects that are not to be shaded are located in the defined surface.

### Hard Copy

In order to document work with PCCAD and quickly output pictures, a hard copy function independent of the graphics hardware is integrated in the PCCAD system. A hard copy can be generated at any stage of work through the corresponding option in the Input/Output submenu. The hard copy routine generates an identical copy of the entire contents of the screen, except for the menu column.

### Parts Lists

PCCAD has the capability to derive a parts list from a drawing. This is a list of all the symbols used in the image, with the pertinent additional information (e.g., order designation). It is stored as a readable ASCII file in the external storage medium, and can be sorted, totalled and printed.

### Design Data

Based on design data, calculations can be performed and the results can be dynamically input into the drawing. To this end, there are registers available that can keep the results of freely definable formulas. These can in turn be linked to variables from the drawing. In this way, surface, volume and any other values can be calculated. The register contents can be depicted in the drawing at defined positions, or maintained in the background. All of the drawing elements generated by PCCAD are available as ASCII values for further processing using other programs or other computers. This means that connecting with numerically-controlled machines or other CAM processing steps can be done comfortably.

### Variation Design

By adding variation design to the mechanical engineering module, it becomes possible to draw up a "mother variation." Through this, the dependencies of the individual lines, arcs and angles to one another are described in simple formula language. The corresponding values can be provided as variables. The instructions for designing any figure are thus reduced to a chain of drawing elements with freely definable variables. By changing only one these variables, for example, an M-6 X 20 screw becomes an M-6 X 35 screw.

### Installation

The PCCAD software is supplied on several diskettes, regardless of computer model. The contents of these diskettes should be copied onto the fixed disk. It is important here that the device driver for the available graphics be loaded into the main memory as a resident program when the operating system is booted by inserting DEVICE = into the CONFIG.SYS file.

The computers must have at least the following features:

—512 K RAM (better 640 K RAM); arithmetic coprocessor; at least a 20 MB fixed disk and 1 diskette drive ; 1 serial interface (better 2 serial interfaces); graphics card, graphics monitor; digitizer board as a dialogue medium.

Special device drivers are provided for computer models with the UNIGRAPH 2100 graphics controller instead of a graphics card. The necessary instructions, as well as notes on entries in operating system files and in the PCCAD system files are naturally included in the extensive user documentation to the device driver. Special features and limitations that have emerged from working with the graphics controller are also discussed. All necessary adjustments are made in the software. It is possible to couple the graphics controller with the EC 1834 or with the A 7150.

This CAD system, with all the noted sector-specific modules, will be sold for EC 1834 and A 7150 by VEB Robotron Accounting Machine Work, Karl-Marx-Stadt, beginning in January 1989. Sales for compatible computers will be conducted by VEB Control Center for Applied Research.

## FACTORY AUTOMATION, ROBOTICS

### Industrial Robots at Hungary's Hodgep Lathing Unit Described

*25020031b Budapest GEP in Hungarian*
*Nov 88 pp 413-415*

[Article by Endre Kovacs, Rabomatik Engineering Office, Gyor, and Janos Tanczos, Hodgep Enterprise, Hodmezovasarhely: "A Lathing Manufacturing Cell With an Industrial Robot"]

[Text] The article describes the characteristics of a lathing manufacturing cell put into operation at the Hodgep Enterprise.

The Rabomatik Engineering Office developed the manufacturing cell on a commission from the Hodgep Enterprise and the cell is presently in test operation.

An overhead view of the cell can be seen in Figure 1. As a first step it was developed for the machining of axle type parts but it had to be remembered that in the second step it must be made suitable for the machining of disk shaped workpieces as well. This supplementation is presently under way.

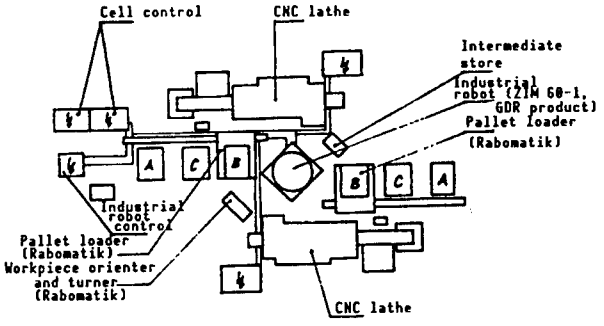


**Figure 1. Layout drawing of the manufacturing cell.**

The chief parts of the cell are:

- 1-2: two EEN-400 model CNC lathes, made by SZIM [Machine Tool Industry Works];
- 3: One SZIM 60 industrial robot, a GDR product;
- 4-5: Two pallet loaders, Rabomatik;
- 6: One turner-centerer, Rabomatik;
- 7: One intermediate store, Rabomatik.

In addition the existing producing machines of the factory were built into the cell, with the necessary additions. Thus, for example, the original structure of the CNC control had to be supplemented to be built into the system, it had to be made suitable for computer communication and automatic door movement had to be built in.

The chief operating modes of the cell are:

—the machines have parallel operation, that is both lathes operate independently and the industrial robot doles out workpieces from its workpiece store with the aid of a manipulation of the pallet loader belonging to the machines,

—the two lathes have serial operation, so a workpiece finished on one lathe goes to the other machine (e.g., in a reversed state),

—one machine works with robot serving while the other works with traditional manual serving (e.g., if only a few workpieces need to be prepared),

—both machines are manually served, with the automatic system in a disconnected state.

The pallet loaders are very important elements of material management by the system. The essence of these loaders is that the workpieces placed on the pallets must be loaded into the receiving site (A) as unit consignments; from here the pallet loader always takes one pallet and carries it to the work area of the robot (B) where the robot feeds and replaces the workpieces with or without a feeder. At the designated place (C) the pallet loader makes up a unit consignment out of the pallets full of finished workpieces; this consignment can be shipped or can be connected into some forwarding system.

This manipulation device is also suitable for material movement in a flexible manufacturing system for it can be built in different sizes and with different skills (e.g., by building in NC axes).

#### The Electric System of the Cell

A block diagram of the control can be seen in Figure 2. The control of the manufacturing cell consists of a cell control and of controls for robot and lathes.

The cell control is based on a Klockner-Moeller PS24 freely programmable logical control and it performs the following tasks:
—maintains contact with the monitoring computer,
—coordinates operation of the cell,
—connects and controls the robot and lathe controls,

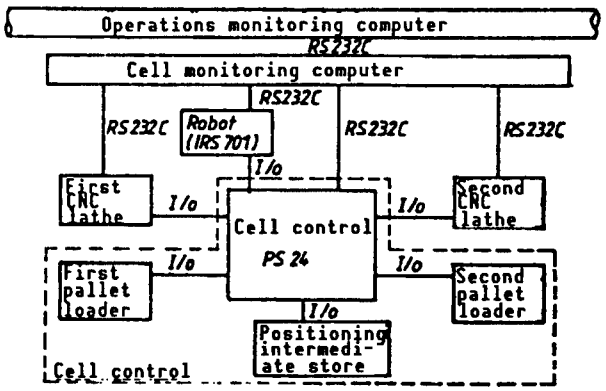


**Figure 2. Block diagram of the cell control.**

—controls operation of the palletizers and other peripherals,
—performs limited error diagnostics.

Control of the lathes is based on a Hunor 712 PNC control which was remodeled to make it fit into the cell.

Control of the robot is by a VEM NUMERIK IRS 701 control with the ZIM BERLIN system program. The permanent main program of the user program maintains contact with the cell control and makes control possible. The programming of the manufacturing cell consists of programming the cell, the robot and the lathes. The cell can be programmed freely with task-oriented codes; the programming technique can be mastered and run quickly. There is no need for a special programming study course.

The programming technique for the lathes is unchanged.

Special instructions serve to program the robot; these are made up of the original program language. Thus the programming technique became substantially simpler.

Every control in the manufacturing cell is connected to the superior computer.

### Small Computer Monitoring of the Manufacturing Cell

The small computer takes care of three tasks:

1. Preparation and monitoring of the machining program for the machine tools. Preparation of the serving program for the robot.

2. Loading and reloading of the machining and serving programs, correcting them into elements of the manufacturing cell. Setting operating modes and number of workpieces.

3. Handling error messages received during machining, displaying error cause and precise time on the screen and journal printer. Querying initial states.

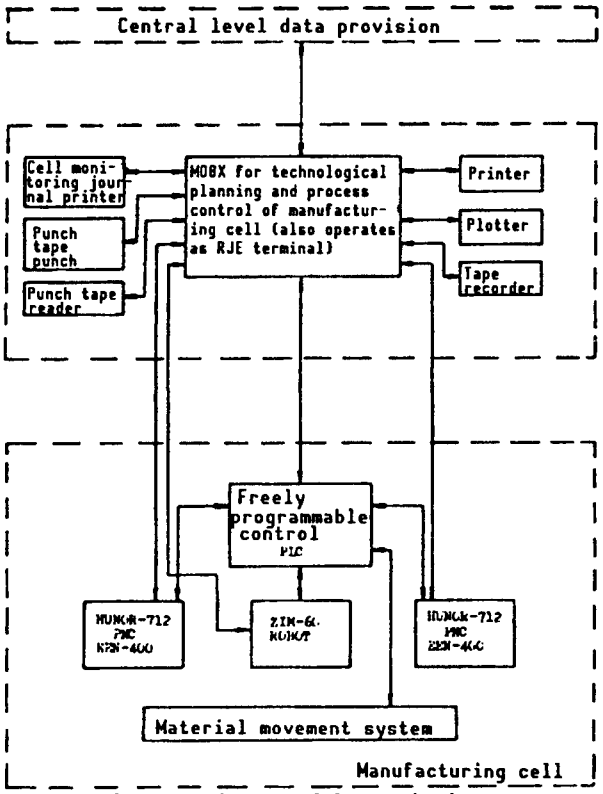


**Figure 3. Block diagram of the monitoring system.**

A block diagram of the monitoring can be seen in Figure 3.

A more detailed content of the several tasks:

An NC technologist with precise knowledge of the controls and instructions for the working machines can prepare the machining program in the conversational mode—in a manner similar to the original controller—and can store the finished program on a floppy disk. After graphic processing the programs written for the HUNOR 712 controllers can be checked on screen and on an x-y coordinate plotter. The programs prepared on the controller can be read back and translated into an editable format. It is also possible to store programs on an analog tape recorder or on punch tape, and then read them back, to aid the programming of working machines outside the manufacturing cell.

When switching the manufacturing cell over to a new workpiece it is possible to load the machining and serving program (or programs) from the small computer into the selected manufacturing cell element on V24 lines. It is also possible to read back and store programs which may have been modified during machining. One can also set the necessary operating mode and the number of workpieces per machine.

One can influence the functioning of the manufacturing cell with the aid of direct commands and one can query the current values set.

When preparing or checking the machining program one can obtain a number of different error signals from the PLC checking and guiding the processes within the manufacturing cell.

The 35 signals include a group referring to a so-called "shut-down error" and another group serving only as a signal or informing about the condition of the manufacturing cell. The functions of the MONITORING program which influence the manufacturing cell can be implemented from the small computer only if the control program senses that the manufacturing cell is switched on and that the operating mode switch is in the "computerized operation" state.

The commands of the presently working monitoring system which can be selected are:

**BASIC OPERATIONS SELECTION MENU**

P: DIRECT COMMAND FOR CELL
U: SETTING MANUFACTURING CELL OPERATING MODE
M: PREPARING, CHECKING MACHINING PROGRAM
K: PROGRAM STORAGE
B: READING IN PROGRAM
A: RELOADING PROGRAM
V: READING BACK PROGRAM
R: ROBOT PROGRAMMING
O: SETTING, QUERYING CLOCK
D: SETTING NUMBER OF WORKPIECES
H: AUXILIARY PROGRAMS
S: RETURN TO SYSTEM.

Our plans are:

—to rework small computer monitoring for IBM PC compatible machines,

—to realize part size, tool and machine monitoring.

In addition our expansion ideas include:
a. refining graphic preparation and checking,
b. automatic preparation of machining programs on the basis of base data,
c. preparation of error and time statistics,
d. more detailed error diagnostics,
e. a technological automated technical design system,
f. inclusion of machining centers outside the manufacturing cell in program preparation and monitoring,
g. a modular structure of the commands which can be selected, as a function of the machine tool and robot controls used and the functions which can be interpreted.

The Elektro-Mechanikus Service GMK [economic work association] prepared the design and implementation of the small computer monitoring of the manufacturing cell.

## Hungary: Automatic Manufacturing System at Csepel Auto Factory

*25020031a Budapest GEP in Hungarian Nov 88 pp 408-412*

[Article by Endre Kovacs, Rabomatik Engineering Office, Gyor, and Gyula Kovacs, Csepel Auto Factory, Factory No 3, Eger: "An Automatic Manufacturing System in Production"]

[Text] The article describes the designing, installation and operation of an axle manufacturing system put into operation at the Eger factory of the Csepel Auto Factory.

Parts for utility vehicle transmissions are manufactured at the Eger factory of the Csepel Auto Factory. The growing domestic and international markets are presenting the factory with increasing quantitative and qualitative demands which it satisfies with planned manufacturing development and work organization. Within the framework of manufacturing development the axle manufacturing system to be described was realized, using central support in connection with OKKFT [National Medium-Range Research and Development Plan] subprogram A/2 and on the basis of the OMFB-IpM [National Technical Development Committee-Ministry of Industry] robot applications competition.

The development of metal cutting technology has been continuous in the area of both machines and tools. The use of very productive CNC machines and TiN multicoated, long lasting hard metal tips led to a significant reduction in machining times. In the case of manual serving of these machines this requires hard physical work.

Operating the CNC machines, which demand great intellectual preparation, doing the precise dimension checks, requiring precision, and the need for greater physical effort are conflicting demands. The raw mass of the transmission axles is between 20 and 27 kilograms. Taking into consideration the piece times of about 5 minutes the mass lifted by one worker per shift exceeded even 5,000 kilograms. The efforts to reduce the physical work with simple lifting equipment (turning cranes, pneumatic weight balances, etc.) were not successful. They significantly increased the manual time, working with them was demanding and the workers did not like to use them, preferring to lift the heavy pieces by hand. The automatic manipulator manufacturing system introduced brought a real solution.

The manufacture of parts for the main units of utility vehicles is done in developed industrial countries in accordance with the requirements of large series manufacture, usually on single purpose manufacturing lines. In our country, disregarding a few exceptions, the number of main units corresponds to medium series manufacture which requires substantially more flexible manufacturing systems in the interest of suitable use of the equipment.

The manufacturing system discussed here had to be able to machine 11 types of axles for three different gear box families based on the building block principle. Rabomatic was commissioned to develop the system, to be built by the Gyor Machine Factory of Tungsram and, in part, by the Eger factory of the Csepel Auto Factory.

The basic conditions for creating the manufacturing line were the following:

—the existing machine tools had to be built into the system, if necessary with supplements and remodeling,

—it had to adapt to the existing materials storage and movement system of the factory,

—it had to follow the available sites in the existing factory hall,

—the indicated dimensions had to be checked at test stations outside the machines, and

—workpieces had to be loaded in and out from unit consignments on the manufacturing lines.

A decision preparation study was prepared in 1983 to study the feasibility of the system. On the basis of this there was a decision on the chief solution line to be considered in the course of preparing the implementation plans. Rabomatik prepared the plans within 6 months from receiving the commission so documentation was available to workers from the middle of 1984.

Manufacture at Gyor was completed in October 1985 and the system was installed in Factory No 3, in Eger. Putting it into operation took about 3 months. Thus the system has been operating in three shifts since March 1986.

**Description of the Manufacturing System**

An orienting drawing of the manufacturing system, a view from above, can be seen in Figure 1.

The machines built into the system (in Figure 1) are:
—one FXLZD-160 final machining center drilling machine (a GDR product) in remodeled form (1),
—two SDNC 530 Csepel-Heid CNC lathes (product of the Csepel Machine Tool Factory) with appropriate supplements (2 and 3),
—one special purpose marking machine (4), a Rabomatik development.

The workpieces enter the rolling store (5) at the front end of the system in a storage stand constituting a unit consignment. Five workpiece pallets can be placed in the storage stand. There are five workpieces on each pallet so a unit consignment of 25 workpieces can be stored. Nine shipments can be placed on the rolling store, which as an average ensures a load for about 1.5 shifts.

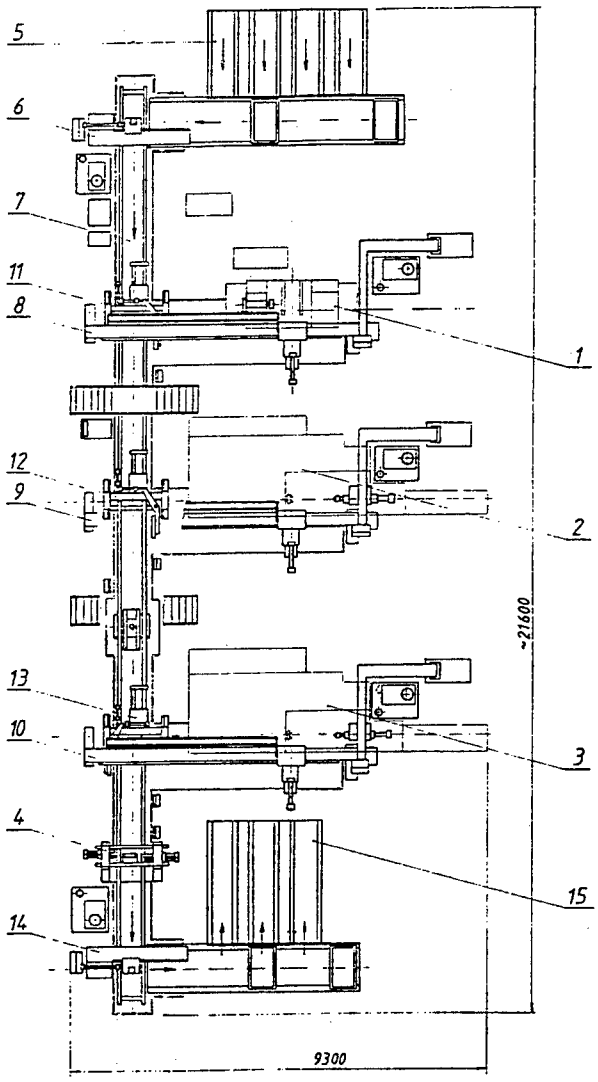


**Figure 1. Structure of the Manufacturing System**

The storage stand must be moved with a car by hand from the rolling store to a loading site beside the transport track; a loading manipulator (6) loads the pallets from the site onto the constantly moving transport track (7) until the track before machine no. 1 is filled. If it is filled the loading automatically stops, but in the event of a certain consumption the loading process automatically begins.

At machine No 1 the end plate of the axles is machined, a center is drilled and a base surface is turned on the left side. The workpieces are placed in the machine and the finished pieces removed by an upper track programmable manipulator (8). The movement of the manipulator between car, transport track and machine takes place during the time of machining. The manipulator loads the

finished workpiece into the test position (11) where a check is made for length, base diameter and existence of the center hole.

Machine No 2—a Csepel-Heid SDNC 530 E CNC lathe—machines one half of the axles. Again an upper track programmable manipulator (9) loads the machine with workpieces. This machine also has a test station which checks the designated diameters and lengths.

The structure of machine No 3 is practically identical with that of machine No 2 with the difference that after machine No 2 turning equipment built into the transport track turns the pallet full of half finished workpieces 180 degrees, so the unworked half of the workpiece is put into the machining position. This machine also is served with workpieces by an upper track manipulator (10) and the finished workpieces are placed in a test station (13) where the designated dimensions are checked.

With this the metal cutting machining in the system is practically finished.

The task of machine No 4—a special purpose marking machine—is to punch in the necessary number marks, which it does entirely automatically. At the end of the transport track an off-loading manipulator (14)—which essentially corresponds to the loading manipulator at the front end of the track—makes up unit consignments from the pallets full of finished workpieces. These unit consignments can be placed in a rolling store (15) the capacity of which is suitable for storage of the workpieces finished during about 1.5 shifts.

**The Machine Tools Built Into the Manufacturing Line And The Remodeling of Them**

a. At the first station we had to use a GDR made FXLZD-160 final machining/center drilling machine, which is about 10 years old. Considering that the existing machine was not suitable for turning the base diameter and machining the large (14-20 diameter) center hole on a few workpiece types we had to design and make a new machining unit for the left side of the machine. Use of this machine, the remodeling and adding to it, is a typical example of how a machine, written off to zero as they say, can be made suitable for inclusion in a manufacturing system.

b. The SDNC 530 E model Csepel-Heid lathes. The basic structure of the machines available and which could be considered at the second and third stations was not suitable for connection into an automatic system.

Experience at the Csepel Auto Factory proved that the tailstock on the machines was not rigid enough, was slow and not provided with automatic fixing. The task description stipulated that the machines must be supplied with suitable tailstock. The new tailstocks have proven well in practice. The machines had to be supplied with automatic door mechanisms.

**A Few Characteristics of the Manufacturing Line**

—In the traditional operating mode the lathe operation times on the two CNC lathes showed a significant spread, which has significance in loading the machines and in the pace of the system, even in the case of significant built-in buffers. So there was a certain balancing of the operation times with technological modifications—within the limits of the possibilities.

—Five pallets can be placed on the transport track before and after the several machines, which means 25 workpieces. In accordance with this quantity of workpieces the work performed by the several machines is independent from the others, in accordance with a buffer of about 1-1.2 hours.

—Machines 2 and 3 set the pace of the line in accordance with the operation times.

—Hydraulic power units operate the serving system.

—A few characteristics of the electric control: A block diagram of the control can be seen in Figure 2; control is provided by Mecman "PLC mini" units; the system has five electric cabinets and ten operating tables; a comprehensive, easily accessible emergency stop system is built in.

—The several machines can be switched on or off freely from the system, naturally taking into consideration the technological possibilities. Thus, for example, if machine No 1 is down for a long time the operation can be done on a machine outside the system and then these workpieces fed back into the system, and any machine can be operated with manual serving as well.

—In case of need the system can be expanded. For example, new machines can be included in the system or new workpieces can be introduced within the limits of the given parameters.

**Experiences Putting It Into Operation**

—The machines built into the manufacturing line had done daily production tasks even earlier. Thus there was no possibility of handing them over to the manufacturing site. So there was a so-called simulation test there, operating the system without the machines. We think this solution should be followed in the future too, because this can significantly shorten the time of on-site installation and the problems arising can be solved more quickly and efficiently. It must be noted that activating the system in this phase requires intensive designer cooperation for here the designer meets for the first time the ideas on paper with the real operating conditions.

—This method made it possible for the manufacturing experts to make the final installation in a relatively short time. During on-site installation the machines

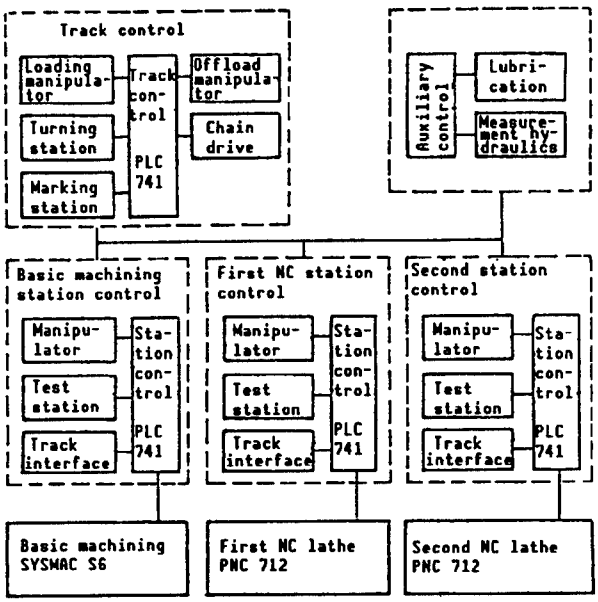


**Figure 2. Block diagram of the control of the manufacturing system.**

were put into their final positions and only then was it possible to do the remodeling of the two CNC machines from both the electronic and mechanical viewpoints.

The machines had to be taken out of production for about one month and so the factory had to take care to manufacture a suitable number of parts well in advance. In the first phase the machines, in their supplemented form, had to be made available for production in the traditional manual operation mode so that while the other tasks of putting the system into operation were being done production could be started on the machines. Then the two CNC machines were sometimes used for system tests and sometimes for production so there was a need for good cooperation and regular harmonization according to the daily needs of designer, contractor and customer. In our judgment this practice is unavoidable in the case of similar systems where existing valuable machines must be used. In regard to the future one can draw the lesson that the remodeling of the machines should be done before the serving system is put into operation so that already remodeled, tested machines go into the system. And probably in this way the interests of production can be taken into consideration better.

—In the phase of putting the system into operation one of the biggest problems was caused by die forged pre-products. A significant number of the forged axles did not meet the prescriptions of the standard in regard to either size or form.

The chief errors were:
—a larger size spread than the tolerance set in the standard,
—burr removal was not satisfactory,
—cleaning of the tool was not satisfactory, so form errors appeared,
—there were many form errors (e.g., deformed cross section).

The serving of the machines and of the test system was finally reliably solved with a number of little ideas (technological and operational), which means that independent of the bad quality pre-products the reliability of serving is practically 99 percent. If a loading problem arises then automatics built into the system note it and stop the given functional unit and indicate the error.

**Operational Experiences**

—Putting the system into operation required the coordinated work of the designer, several contractors and the operator. This requires special organizational and leadership activity and suitable authority on the part of the coordinating leader.

—The system fulfilled the hopes held for it in the area of eliminating difficult physical work and ending cart material movement between machines.

—The work of three machine operating and one material moving physical workers was eliminated.

—The throughput time for parts manufactured on the manufacturing system was shortened.

—The scrap percentage for operations done here was reduced thanks to use of the test systems built into the manufacturing line and thanks to the extra time which could be turned to checking by workers freed from the loading and unloading of workpieces.

—Operating the equipment requires a different work style compared to that for individual machines. The correct frequency and order of the many-layered monitoring checks and the use of divided attention developed nicely with the increasing practical experience.

—The workers liked work done on the manufacturing line because of its higher level, small physical burden and last but not least its efficiency in production.

—The wage payment work category system based on complexity of work and the difficulty of work circumstances did not contain a category applicable to such work, one had to be worked out.

—The workpiece feeding manipulators and their controls are working reliably.

—A significant part (90 percent) of the interruptions which have arisen thus far in connection with the manufacturing line arose from failures of the machines built into it.

—The total of downtime due to interruptions is not greater than the average.

—Maintaining and repairing the system requires maintenance experts with greater than average theoretical and practical preparedness. Since such people are, in general, not always available and since from the viewpoint of lost production an interruption of the system means more than in the case of a single machine being down it became necessary to build up a multistep telephone duty system.

—In the case of work done on individual machines the machine cleaning and care at the end of the shift, together with the system service done by maintenance, was sufficient. In the case of a continuously operating system this is not possible for care of the entire equipment requires substantially more time. So it became necessary to insert so-called service days when this can be done with the coordinated work of the system operators and the maintenance organization. Suitable technology for this was developed as well. Developing the organizational and labor affairs conditions for the service days is a task still to be solved.

—During operation so far the operation of the test measurement systems has caused the biggest problem. The combined mechanical, hydraulic, pneumatic and electric structure of the instruments manufactured by MASSI results in complicated operation and less reliability in many parts of the equipment. Setting the two-point pneumatic instruments (AH-FH) with master axes is difficult, requiring much practice and relatively much time. We chose the instruments in order to save capitalist foreign exchange, because others cannot be obtained in the CEMA relationship. We are presently studying the possibility of buying sensors and indicators from the capitalist relationship and using test measurement systems of our own manufacture.

—In sum it can be said that the operation of the system thus far has basically brought the expected results. It is of especially great significance that the operators got much experience from the viewpoint of operations and organization. This is a guarantee that future use of manufacturing systems in the factory will be successful and by using the present experiences we can go forward toward use of computerized guidance, increasing the degree of flexibility.

On the basis of operation thus far, and on a commission from the Eger Organization of the GTE [Machine Industry Scientific Association], colleagues from the Industrial Management Institute of the Heavy Industry Technical University did an economicalness study. A comparison of shop system manufacture and manufacture on a manufacturing system was done on the basis of a complex scoring system. Manufacture on a manufacturing system is 30 percent more efficient than the earlier manufacturing organization form from both the technical and economic viewpoint.

—The next system planned for realization, for which Rabomatik has already developed a technical plan, has been approved by a jury on behalf of the Csepel Auto Factory and hopefully it will be realized in the near future, after ensuring the financial conditions. The degree of flexibility of this system will be significantly greater, it will be suitable for computerized communication and it will be developed with screen error diagnostics.

## LASERS, SENSORS, OPTICS

### GDR's Carl Zeiss to Export VLSI, Precision Optical Equipment to PRC

*23020038 Beijing ZHONGGUO JIXIE BAO in Chinese 11 Dec 88 p 3*

[Text] The "Carl Zeiss" state-operated enterprise is the German Democratic Republic's high-tech and precision optical equipment center. It is engaged in research, design, production and export of microelectroni equipment and machines, very-large-scale integrated circuits (VLSI), high-vacuum equipment and precision optical instruments. Its main line of products includes optical analysis equipment, lasers, medical optical instruments, astronomical equipment and facilities, planetarium equipment, geological survey and measurement equipment, machining measurement instruments, photographic equipment, telescopes and sighting devices. The Carl Zeiss Combine makes about 800 different products and exports a variety of items, here we introduce a selected few.

#### ZBA21 Electron-Beam Exposure Unit

The high-precision electron-beam exposure unit made by Zeiss is used in the production of 4MBit-and-smaller VLSI DRAMs [dynamic random access memory chips]. The template and semiconductor plate are simultaneously formed.

The ZBA21S electron-beam exposer may be used in the processing of 1:1 prototype boards and 1:x circuit-diagram primary boards on corrosion-resistant chrome-glass substrates up to 7" x 7". In designing and manufacturing VLSI/ULSI circuits, the ZBA21S may be used in the processing of semiconductor boards with diameters up to 150 mm and containing micron-scale or submicron-scale components.

#### AUeR2 Automatic Repeated Exposure Unit

In the process of installing semiconductor components (a VLSI circuit has 4 million components) onto a semiconductor board up to 150 mm in diameters, a high-efficiency, fully automatic exposure unit is used to transfer the components repeatedly onto the semiconductor board until the integration reaches 1-MDRAM.

### BET150 Purification, Painting and Cleansing System

The BET150 system is used in the production of VLSI circuits to perform high-efficiency and fully automatic chemical purification, front face painting and cleansing of 100-mm and 150-mm-diameter silicon wafers. The system, configured in modular fashion, is built for continuous operation. It contains the circuit module, the framing module, the control module, the power module, the purification section (BET1301), the painting section (BET2302) and the cleansing section (3302). The system is easy to operate and maintain. The two power circuits are totally independent and the operation is fully automated. A number of micro-controllers are commanded by the control panel and the computer. The industrial process can be programmed and there are ample diagnostic and service procedures.

### Zeiss Microscope

The Zeiss industrial-grade reflecting microscope is equipped with a movable achromatic lens on its micromotor-controlled objective rotation mechanism. The magnification range is 25 to 1600 and the microscope may be used for observation and photography. The frame is characterized by its high stability. Ergonomically, the controls are sensibly designed, viewing height and angle are adjustable and the unit has its own power source (incandescent lamp up to 100W). The area of the platform for specimens can be changed. For observing wafers less that 6" and photographs less than 7", the platform area is 155 mm x 155 mm. The unit comes with a number of accessories. A polarization interferometer, an illuminator, a fluorescence unit and a microfilm camera to be selected at the user's option.

### Jenavert Reflecting Microscope

The upright reflecting microscope may be used in the observation of metals, minerals, ceramics, plastics and semiconductors with the naked eye. The structure is sturdy and the controls are convenient, and it comes with a chromatic lens. The reflecting microscope offers the buyer a wide selection of optional accessories, such as an mf-AKS microfilm camera, a differential interference comparator, advanced polarizers, a wafer polishing stage, and microhardness tester (mbp-60). Model varieties include a JENAVERT-bright field/dark field, a JENAVERT-large field/bright field, and a JENAVERT-large field/bright field/dark field.

### Neophot 32 Reflecting Microscope Camera

This large rotatable reflecting microscope camera is very useful in the observation of metallic materials, minerals, ceramics, plastics, and semiconductor wafers. It is characterized by its sturdy structure and ergonomically convenient controls. It is equipped with a large-field manual-achromatic lens/chromatic lens. The central image is smaller than or equal to 32 mm. The light sources are a xenon lamp and halogen sources. It has a microfilm camera, with automatic exposure units for sizes from 24 mm x 36 mm up to 8" x 10". The camera accessories are made according to commonly used international standards. Options include a quantitative and qualitative analysis polariscope, an interference comparator, a microhardness tester, various measurement and recording devices and magnifier and television attachments.

### ULM01-600c/c1 General Purpose Range Finder

This horizontal-axis, single-coordinate range finder uses a mechanical method or a force-free electrical measurement mode. It is capable of making precision measurements of direct differences. It can be used to measure external dimensions of two-dimentional objects and cylindrical or spherical objects. It can be used to measure the chamfer angle, diameter and pitch of inner and outer threads, and is especially suited for calibrating gauges. It employs a micro-difference system, digital display, and microprocessor control. Operation and analytic computation are its strong points.

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## METALLURGICAL INDUSTRIES

### Possibilities, Limits to Future of Hungarian Iron Metallurgy

*25020028 Budapest KOHASZAT in Hungarian*
*Sep 88 pp 385-390*

[Article by Jozsef Mezei: "Technical-Economic Possibilities and Limits of Innovation in Iron Metallurgy"]

[Text] After its exalted development in the 1950's, its subsequent sudden standstill, and the crisis manifestations of the 1980's, the sober-minded definition of the new tasks of iron metallurgy, fitting it into the process of the structural transformation of the national economy, is on the agenda these days. This requires a source analysis of the problems of the current situation, and an evaluation of the technical possibilities of advancement taking into account the limiting economic conditions. The most important tasks are the modernization of product structure by increasing the share of quality steel products, a considerable decrease of production costs, and the suppression of uneconomical production.

Iron metallurgy has always played an important role in domestic industrial production and production structure. Nevertheless, the assessment of its importance and future—not always in harmony with the actual results—kept changing between wide limits. During the postwar period of rebuilding and the development of the socialist industry, iron metallurgy had an outstanding role as a result of which the steel industry, which served as the basis of domestic industrial production, was established by the end of the 1950's; it was able to adequately supply

nearly every branch of industry with domestic materials; moreover,—because of a favorable exploitation of capacities—export production could also begin in several sectors. The foreign market connections of iron metallurgy, important also for the national economy, were developed simultaneously.

In response to world market developments in the 1970's, the importance of iron metallurgy diminished also in our country. In the first half of the 1980's, even such extreme views were formed that it was not merely a necessary burden but an industrial branch to be eliminated; this, in spite of the fact that, during the first half of the 1980's, Hungarian iron metallurgy did fulfill the national economic tasks prescribed for it even under the pressing external and internal conditions. It supplied the domestic users with a sufficient amount of steel products of a quality which could be expected under the existing technological and technical conditions; it delivered on commitments made to socialist partners; it produced for hard currency export the share of goods projected for the branch in the annual national economic plans, and thereby it also acquired significant convertible assets from year to year.

Examining the management of the iron metallurgy enterprises we find that the economic situation of some of them had become unfavorable already by 1980, and in subsequent years, there was a gradual decrease in the productivity and effectiveness of every enterprise within the branch. Because of the general depression, the recession in the steel industry, and the unfavorable external and internal changes, the financial balance of enterprises—particularly those with a basic vertical structure—was shaken; by 1986 already, state interference was required to ensure their operational effectiveness.

The rapidly occurring and lasting decrease in the effectiveness of the sector, the collapse of the financial stability of large enterprises, was precipitated mostly by the following concrete causes:

- Production decreased to a significant degree and was enduringly stabilized at this level, as a result of moderation in domestic and foreign market demands. Between 1981 and 1985, the average annual production volume was below that of 1980 by 7 percent and that of 1979 by 15 percent, but the decrease was 20 to 25 percent compared with the enterprise plan projections.
- The rapid increase in the average price of energy carriers: compared with the year 1979, there was an increase of 87 percent in 1980, 115 percent in 1981, 157 percent in 1983, 157 percent in 1983 [sic] (the average GJ-price was 62 forint in 1979 and 156 forint in 1986). Because of the price increase, since 1980, the producers were burdened by 5 to 9 billion forints in excess costs in spite of the fact that, as a result of their technological efforts, there was a decrease in both total and specific energy usage.
- Interest costs increased several fold, not only as a result of the large amount of loans taken out for metallurgic developments during the second half of the 1970's, but also because of the steep increase in interest rates.

These changes, individually, caused damage on the order of billions to the "starting" profit of the sector which was 3.6 billion forint in 1976 and which, incidentally, did not provide the enterprises with full self-financing in the 1970's because the domestic prices of steel products were kept at a low level. In addition to the above mentioned, of course, many other factors also influenced enterprise management, such as the increase in basic material prices, the more stringent regulatory system, and the errors and deficiencies in management, regulation and planning, the combined damaging effect of which was not counterbalanced by the increases in domestic prices and subsidies.

Mentioned just as an example, the level of costs was increased from 90.1 percent in 1979 to 98.7 percent in 1980 and to as much as 107.7 percent in 1985. During the same period, the net share of materials increased from 65.1 to 77.3 percent and the energy costs from 8.5 to 17.1 billion forints.

At the same time, the stabilization of the material costs at about 77 percent, and, within that, the cost of energy fluctuating between 22 to 24 percent, indicates not only the massive distortion in the cost ratios of steel products and energy but also the untenableness of the very high specific energy consumption. First of all, the energy consumption of crude iron production is higher than justified. The enormous energy requirement of poor quality ore (20 to 22 GJ/t) and, consequently, the burden cost, considerably exceeds the burden costs of crude iron production in industrial countries which use good quality ore. The higher levels of production are also automatically condemned to non-competitiveness by the high burden cost and production cost of crude iron. The cost of the use of alloying materials, casting dies and rolls is also higher than justifiable. Maintenance costs have been a very sizeable item in enterprise budgets for a long time. In 1980, 6.4 billion forints, in 1985, already 8.4 billion forints were spent for this purpose. The scale and dynamics of the costs is closely associated with the extensive wear-and-tear of the fixed assets and the low level of organization of maintenance activity.

In this sector, the proportion of totally depreciated but still running fixed assets is very high, much higher than in industry, overall. In 1985, it was 29 percent in iron metallurgy and 19 percent in industry, in general.

Measured on any kind of international scale, productivity is exceedingly low; this is caused by the small proportion of direct producers, outdated production equipment in several places and certain employment policy considerations.

As a result of all these, the net balance of the sub-sector decreased to 570 million forint by 1985 although it was 1.5 billion forint in 1986 [sic].

With respect to the technical level of Hungarian iron production, the metallurgical area has by now acquired, through the steel industrial developments completed in the early 1980's, satisfactory working conditions in general, and technical and management type equipment and technologies which can withstand international comparison.

The situation is different, however, in the field of rolled goods production. The most up-to-date factories started to produce in the mid-1970's and the oldest ones are nearly a hundred years old.

The manufacturing of rod and rolled section goods is the most neglected area of rolled goods production the development of which, to an adequate level, has remained unsolved for a long time in spite of existing demand. With few exceptions, the rolling mills are antiquated and, therefore, the economy of production is of course much below average. Modern sections—such as the parallel-sided beam, for example—are completely lacking but there is no adequate production of small, simple sections either although great and lasting demand for these is expected also from abroad.

Regrettably, our enterprises are halting production mainly of these products, primarily because of their labor-intensiveness, although they would make the acquisition of very valuable products possible—for example tinplates—on the socialist product exchange. Because of their technical level and the economic problems stemming from it, quite a few areas of metallurgical finished goods production, such as a significant proportion of forges and foundries, are already in a situation such that, in the absence of adequate intervention, they will be forced to halt production in spite of the fact that there is an unchanged demand for their products, moreover, a demand for increasingly better quality products.

With a strong influence on the profitability of iron metallurgy, advanced processing, that is, the manufacturing of secondary and tertiary products in iron metallurgy, also provides a heterogeneous picture at the individual enterprises. Of the enterprises having a basic vertical structure, Dunai Vasmu [Danube Iron Works] has the greatest advanced processing capacity as indicated by its products: steel structures, radiators, bent profiles and pipe coils produced.

As further processing of rod and rolled section goods, LKM [Lenin Metallurgical Works of Diosgyor] produces drawn, stripped and polished steel bars, mine props and heat-treated screws [meleg csavar]. OKU [Ozd Metallurgical Works] manufactures primarily rolled profiles of commercial quality, its further machine processing is insignificant and, thus, it is the largest cooperative supplier of the processing enterprises, such as SKU [expansion unknown], BnL [Borsodnadasd Metal Sheet Factory] and D4D [expansion unknown].

According to the 1986 resolution of ATB [State Planning Commission], the most important task of iron metallurgy is to supply the domestic processing industry at the highest possible quality level. This requires a broad spectrum of metallurgical products, continually expanding with new products with a simultaneous increase in quality demands. Also keeping the rentability aspects in view, one can see that this is not a small task of technical and production management. Compared to the relatively small production volume, Hungarian iron metallurgy manufactures a large selection of products and, therefore, the absence of economical production is not at all surprising. On the other hand, making the production economical requires the implementation of a product-structure transformation program in Hungarian iron metallurgy where a large role will be played by the international cooperative relations of Hungarian iron metallurgy.

Of the iron metallurgy products, in 1986, 1609 kilotons were sold domestically, 225 kilotons in ruble and 691 kilotons in dollar exchange. During the Sixth Five-Year-Plan period, domestic consumption and hard currency export were lower while socialist export increased.

The income from iron metallurgy is derived primarily from domestic and hard currency sales. The income from socialist relations is not of definitive size although it more than doubled. On the other hand, the hard currency export-import, in spite of the decreasing volume, made a positive contribution of $100 million to the improvement of the balance of payments.

Beginning with the 1980's, domestic consumption of metallurgical products decreased. This came about because of a specific consumption decrease in the machine industry, the greatest user, (in 1980, 6.3 ton/billion forints, while in 1986, 3.7 ton/billion forints); the moderate industrial development during the Sixth Five-Year-Plan period (instead of 19 to 22 percent, only 12 percent); the 12 percent decline in the construction industry; and restrained investments. As a result, the total iron metallurgical product consumption by the national economy decreased by more than 100 kilotons over the 5 years and it remains at this level today.

The changes that occurred in foreign markets have the following characteristics. In the socialist context, our previous, so-called clearing export obligation ceased in 1985. In line with it, according to the intermediate-range agreement entered into by the Soviet and Hungarian planning offices in 1986, the clearing export obligation is of the order of about 100 kilotons/year of which the decisive part consists of rod and rolled section products. Only value contingencies were defined with the other CEMA countries. These are filled on the basis of mutual interest. With the individual socialist countries, iron

metallurgical exchange is developed at the sessions of the permanent work groups for iron metallurgical economic and technical-scientific cooperation, which function within the framework of a bilateral international cooperation, or at the Intermetall product exchange conferences.

The capitalist market situation has declined every year from 1980 on with respect to both sales possibilities and obtainable prices. This unfavorable trend was also magnified by a change in the motivation behind capitalist export. Its effect could not be countered by the means available to iron metallurgy—for example, material and energy saving, cost decrease—and, therefore, the requirement to decrease exporting at a loss was formulated both at the national economic and enterprise level. Under these conditions, the domestic market and socialist export attained greater value to iron metallurgy out of necessity. The development of economical product structure and increase in the income producing capacities of iron metallurgy have become basic requirements.

During the current period lacking in investment capital, one means for improving the effectiveness of iron metallurgical enterprises is to halt the production of uneconomically produced goods. However, this activity cannot leave the consumers without supply from one day to the next. In addition, halting the production of certain products is also frought with the danger that the demand will appear as import, moreover, mostly as capitalist import, because purchase possibilities from the socialist market are very limited. Therefore, the principle that loss items must not be produced (declared by the chamber's president) can only be practiced in countries with freely convertible currencies where no exchange problems are associated with import. Consequently, the metallurgical enterprises strive to satisfy demand with goods supplied by them heretofore. A great role is played here by the cooperative relationship among the enterprises, and by the bi- and multilateral trade activity and technical, scientific cooperation with the socialist countries.

As good examples of efforts made so far, it may be mentioned that:

- DV [Danube Iron Works] stopped the manufacture of perforated sheet iron in such a manner that the entire production equipment was transferred to the Szekszard Agricultural Enterprise where it is currently in operation;
- The narrow gauge rail supply from the CSR halted by LKM, was secured in part through specialization and in part through product exchange.

The activity to transform the product structure is most intensive in OKU where, in connection with the halted rolling mills or rather the replacement of their disappearing products, the experts of trade organizations and technical fields alike have established a broad range of relationships with enterprises of the consumer industry. In this framework they evaluated the current and long range needs of the user enterprises for the given product and they defined the modes for the operational satisfaction of demand and for its long-range supply. In the framework of this effort, the 1987 [sic] needs are met from prefabrication. In order to insure supply for subsequent years, they want to organize the domestic manufacture of the products by alternative rolling mills at other enterprises, on the one hand, and they project acquisition through socialist import, on the other hand.

In view of the fact that the products ordered from socialist countries are more modern and of better quality than were the products of the halted rolling mills, import will also favorably influence the development of an economical product structure for the users. An example is the so-called IPE profile, which replaces the traditional, domestic I-beams where the saving in materials is about 15 percent.

Also trying to promote the more economical functioning of OKU is the action aimed at pulling 30 to 40 kilotons/year of steel for concrete reinforcement from the Soviet clearing import, requesting instead large-sized I- and U-beams and other rolled products which cannot be produced economically at home, and also pipe ring steel products.

The above attests to the responsibility felt by the metallurgical enterprises for supplying users in the course of the structural transformation. However, the more effective mode of structural transformation lies not in the manufacture of traditional products but in the production of new goods, new qualities and more economically manufactured goods as well as the expansion of innovation.

In the Seventh Five-Year-Plan, the most important task of iron metallurgy is to supply the domestic processing industry (primarily machine industry) at increasing levels of quality. Namely, this is one of the conditions for improving the competitiveness and effectiveness of the machine industry which has the most influence on the achievements of the national economy. The supply of the processing industry as stipulated above requires that iron metallurgy be capable of adjusting to the transformation of industrial structure.

At first glance, iron metallurgy appears to be a rigid system, extremely difficult to move. Namely, new production capacities cannot easily be created and the termination of existing ones is also not simple and economical. Nevertheless—within given limits—domestic iron metallurgy is also capable of flexibility. This derives from the multifaceted nature of technological installations; namely, the rolling mills, forge shops and foundries, etc. are all set up so that products satifying various demands, in accordance with the needs of industry, can be manufactured in them. Iron metallurgy tried, earlier already, to exploit this advantage for the benefit of industry and for improving its own profitability. It approached the users with new, more sophisticated materials, of course, at higher prices. However, these prices never covered the expenditures made for product development. A large number of materials, better and

more exacting than the existing ones, were demanded also by industry and iron metallurgy tried to meet these demands within its capabilities. But a problem always arose because of a lack of long-range utilization of the new and better materials: the new materials were rarely requested again by the processing industry beyond the one-time use. The reasons can be sought in the lack of preparedness of the processing industry, the conservatism of the designers and the lack of advertisement by iron metallurgy. Two examples to illustrate the point:

- After two years of experimental research, the Danube Iron Works was able to start the production of high strength, non-brittle and yet easily welded structural steel goods which were needed for the new floating crane, Adam Clark, of MHD [Hungarian Ship and Crane Factory]. The floating crane was completed but, for all practical purposes, the type of steel has not been ordered again although, starting with the new steel structure of the Arpad Bridge, much construction with similar steel structures has occurred since then.
- For the new, 300- and 400-type family of Ikarus, bent steel shapes with an elevated yield point were prepared, also by the Danube Iron Works, the use of which would permit a significant decrease in the total mass of the vehicles. In the course of trial productions it was found that, with its current technology, Ikarus cannot use thinner but stronger support panels, and it would not make sense to manufacture the current, standard-size supports from more expensive, better materials. Thus, the decrease in mass could not be achieved although the appropriate steel is available.

In addition to these two examples, regretfully, others could also be listed. Naturally, all of these are accompanied by unfavorable prospects not only for the machine industry but also for iron metallurgy, because

- accomplished product developments remain economic losses in the majority of the cases because of subsequent disinterest;
- equipment created for production remains unused;
- instead of adequate inspiration, the processing industry thus provides disinterest or, eventually, even a retarding force for the accomplishment of technical developments.

Iron metallurgy also has much to do in the interest of changing this unfavorable situation. Informational and advertising efforts must be definitely strengthened. Although some descriptions appear occasionally in a technical journal, these do not effectively reach the users. Therefore, it would be necessary to prepare an up-to-date catalog, a product description of metallurgical products, which would continuously follow the changes in product structure, to expand the knowledge of the users. Naturally, it would also be important that the builders as well get to know the new metallurgical products and be interested in their use. Therefore, efforts directed at modernization of industry standards must also be increased.

Under the increasingly difficult management circumstances, the relationship among iron metallurgical enterprises was of necessity expanded, information exchanges became regular, cooperation increased; one could say that the enterprises are finding one another easier. Notably, the lack of this was often complained about earlier. However, there is something we must not lose sight of. Namely, that the metallurgical enterprises are also separate economic units. They are obliged to act economically one by one and not as a group; consequently, their interests very often put them in opposition to each other. In the interest of resolving these problems, there have been studies conducted for more than a year to find the organizational form which would best advance productivity. So far, however, the search for an appropriate solution has remained unsuccessful. Although many variations were examined, none of them was suitable to resolve the conflicts of interest or to enhance the common interest, or else they conflicted with existing regulations.

In the course of carrying out the tasks of industrial development, a two-fold, and unfortunately in part contradictory set of tasks were formulated for iron metallurgy, as an industry which produces basic materials. The demands are, on the one hand, the supply of domestic users at a high quality level (coupled with emergency import restrictions) and, on the other hand, the attainment of economical functioning of the iron metallurgical enterprises. While the assurance of supply presumes expansion of selection and technical-technological development, economical functioning necessitates forced stoppages of production, more rapid liquidations, the removal of items from its product profile which are in conflict with demand. It is also a contradiction that the accomplishment of rentability is becoming the most important task in our country at a time when iron metallurgy cannot and does not function in a self-financing manner nearly anywhere in the world. Throughout the years, Hungarian iron metallurgy has not been self-financing since, because of its great demand for equipment, it is unable to achieve it without adequate mobilizable capital. The development fund, derived from sales that can be made at prices depressed in given cases for reasons of industrial policy, from profits which are far below the industrial average even if measured in proportion with the value of the means of production and from the amortization of fixed assets which had been artificially undervalued because of insufficient profits, failed to provide sufficient funds either for a dynamic maintenance of standards or for investments representing technical development. Until the mid-1970's, budget subsidies were given for larger developments; subsequently, the subsidies were converted into payments with a repayment obligation. In enterprises with a basic vertical structure, repayment of loans would have been possible only in cases of very dynamic growth in production volume, a considerable increase in

hard currency prices, and a parallel movement between the price of domestic steel products and energy carriers. As is well known, these conditions were not met by the facts and, therefore, the budget was forced to write off more than 11 billion forints of debt and 5 billion forints of interest between 1983 and 1986.

Examining the economic indicators of the past decade, it is clear that the innovation in iron metallurgy needed to accomplish its tasks as a supplier cannot be accomplished based on its own resources alone, while the pressure for economical operations arises precisely because of the exhaustion of central resources. Thus, the method of task solution which is gaining strength is that which links the producer and the user of the basic materials. In current practice, the goods alone create the connection between them and, apart from that, they have no or very little knowledge of each other's problems or possibilities. In the case of resources needed for innovation, attention is focussed almost exclusively on money, or resources measurable by money, although, in this case, much more must be involved. There are many tasks which iron metallurgy, without the machine industry (or vice versa), could either not accomplish or accomplish only over an extended period, at the cost of great difficulties and expenses. On the other hand, by working together, on the basis of common interests, in addition to the manifold greater efficiency and monetary gain, otherwise unattainable results will also materialize. This can be sensed also through the following two concrete examples.

The completion of the electronization tasks in iron metallurgy are very significant also at the level of the national economy because the effectiveness and quality of the guidance of the material- and energy-demanding metallurgical processes largely defines their economic effectiveness. However, iron metallurgy by itself can only solve this task in small steps, through results hardly perceivable in time, although it has the proper specialized training and equipment in several areas. Participation of the machine industry is needed for effective accomplishment and this has advantages for both partners which can be summarized in the following:

- The accomplishment of such a large-scale task in iron metallurgy produces a stable field of action for the domestic machine industry, with the accompanying possibilities for gaining experience, the size of which already will make profitable electronic developments possible as well.
- In the case of the application of electronic technology, the quality and uniformity of iron metallurgical products improves, and the manufacturing processes can adapt more flexibly to customer demands.
- The improvement in economic results makes it possible that the previous capital investment into the machine industry be returned with profits.

Within the tasks of electronization, the application of robot technology gets an outstanding role. The broad metallurgical application of robot systems is a task of ever increasing importance because the lack of trained workers is greatest precisely in those areas where a robot can best replace the work of man (forges, foundries, other manipulation and purification of hot materials, monotonous, dull and dangerous work places injurious to health). For example, because of a lack of workers, the die-making forge shop of CSM [Csepel Metal Works] would produce much less today if the robot system installed there would not be operational. A few of the simultaneously developed robot systems are undoubtedly expensive but, considering the large receiving market for iron metallurgy and its possibilities for cooperation in the manufacturing of robots, the results which could be achieved by cooperation could be extraordinary for both parties.

Consequently, the processing industry must also take part in the necessary metallurgical innovations. This participation must be based on mutual interests. Namely, the modernization of iron metallurgy is not of isolated iron metallurgical interest but a task of industrial significance which will also affect industrial production as a whole and its efficiency. Should the most important developments be neglected, it will endanger not only the functional ability of iron metallurgy, but the projected and necessary development of the processing industries supplied by it—including the machine industry—will also fail to take place.

In accomplishing the economic tasks, the application of most modern technology and the more extensive utilization of intellectual energies must receive greater emphasis than before.

In conclusion, examining the expected place of iron metallurgy in the industrial structure and its role in industrial policy, taking into consideration also the changes which began earlier, it can be said that the place of iron metallurgy in the industrial structure can be judged to be normal, already today. The trends that made a fetish out of iron metallurgy and the large-scale steel production ideas arising in their wake have ceased earlier. The subsequent negative, disparaging opinions have also slowly subsided as a result of which iron metallurgy today plays a role in the national economy similar to all other specialized branches. It is true, however, one can often hear it even today, that iron metallurgy too is among the so-called kept sectors which are a drain on the national economy and are holding back the enterprises which would be capable of soaring. In this context I shall describe what the changes in budgetary payments and subsidies show. Taking into account all of the factors appearing in the course of their 1986 activities, the iron metallurgical enterprises belonging to MVAE [expansion unknown] provided as revenue for the state, 3.6 billion forints; Metalimpex and Lignimpex added 3.8 billion forints in KUTEFA (socialist-import-skimming), for a total of 7.4 billion forints. They received a total of 6.4 billion forints support, leaving a positive balance of 1 billion forints. The projected figures for 1987 are 7.6 billion forints in payments and 5.1

billion forints in subsidy to be received, with a projected balance of plus 2.5 billion forints. Thus, according to the numbers, iron metallurgy is not among the kept industries. Nevertheless, during the past few years it has become fashionable to disparage and scold our profession. We have to take a stand against this both at the official and the social level. In my opinion, in the evaluation of iron metallurgy, the determinant factor must be that the work and products of iron metallurgy significantly define the activities of the entire, or rather, a large part of the entire industry.

Today, iron metallurgy is looked upon as primarily an autonomous,closed production unit, making it independent from the complex structure of industry. Thus iron metallurgy appears to be a simplified system which consumes material, energy and money, and produces material, energy and money, and its existence and fate is defined by the balance of the two. In the future, iron metallurgy must be granted a greater role in industrial policy because the manufacture and processing of basic materials are similarly important sides of industrial production. Steel cannot be generally replaced with some other material (such as synthetics or ceramics) either today or in the foreseeable near future, just as one cannot build bridges, cranes and halls from electronics.

On the other hand, it is a fact that iron metallurgy must change its production structure: instead of the mostly low grade, so-called commercial steel produced at the present time, an increasing amount of higher quality steel must be offered to the users. Namely, we cannot work competitively in the field of commercial steels because the technical level of the factories does not permit it. On the other hand, technical development is undoubtedly necessary for the production of better quality products, primarily in those technological phases which until now were always left out of development, mostly out of misinterpreted frugality. In my opinion, the preparation of charge material both in steel production and rolling mills, and the finishing operations after the rolling mills must be developed, control must be improved in every area, moreover, in many respects it must be newly established and, after careful consideration, those projects must be developed which are needed for the manufacture of better quality steel products. All this costs money, of course, and that is becoming increasingly scarce. While in earlier Five-Year-Plan periods, iron metallurgy received 22 to 24 billion forints for developmental possibilities, in the Seventh Five-Year-Plan there is only 9 billion forint for this purpose. Without going into details, it is obvious that no basic changes in product structure can be accomplished with that. Therefore, the most economical, most sensible developmental possibilities must b sought which are aimed not at an increase in volume but at the manufacture of more valuable products in the framework of the already evolved and significantly decreased production volume. In this respect, the rolling mill development started at the Danube Iron Works appears favorable which is aimed at bringing about the coil-box technology. The activities at LKM, aimed at developing preparation, finishing and control, can also be approved. And at OKU, in addition to the eventual expansion of continuous casting, the most appropriate mode of developing the rolling mills, primarily the RDH [expansion unknown] must be found. In this context I should like to mention that a significant part of the products disappearing in the course of structural transformation can be obtained through socialist product exchanges if we can offer an appropriate counter product. Our partners are seeking mainly small scale, so-called fine line products: small angular, flat, T-shaped and square steel products. This fact should be taken into consideration in the RDH development.

Transformation of the product structure, the technical renewal also demands a change in the thinking of metallurgical workers and an increase in their professional standing. In this respect, iron metallurgy is undoubtedly in a bad situation, both because of the generally bad situation of the technical workers and especially because of the existing anti-metallurgy atmosphere. Therefore, it is necessary that steps be taken in every field in order to enable us to satisfy the need for specialists for the innovation. In this context, the enterprises, educational institutions and management organs alike play an important role. Without expert specialists who know and are devoted to the profession, the renewal cannot be accomplished.

What final conclusions can thus be drawn from the discussion? Perhaps that the demand for the renewal of iron metallurgy is present on the part of both the national economy and the enterprises. A more modern iron metallurgy, producing more economically than today and working with a reduced number of workers has a place in the Hungarian economy on the basis of both the domestic demand for steel products and the export tasks; therefore, in the midst of the narrow financial possibilities and the generally difficult economic conditions, the metallurgical experts must concentrate their talents on finding those methods which will produce the desired results. It is my conviction that, as a result of a cooperation between the workers within and those outside the field, a healthily functioning iron metallurgy can be developed in the future.

**Footnote**

Jozsef Mezei: Received his degree in metallurgy from the Technical University of Heavy Industry in 1957. In 1962, he received a degree in engineering management of the metallurgical industry, from the same university. He is executive director of the Association for Hungarian Iron and Steel Industry. He has been a member of our association since 1955. Since 1985, he has been chairman of the department of iron metallurgy. His specialty is the planning, organization and realization of investments.

# MICROELECTRONICS

## GDR: Meeting Domestic Demand in Microelectronics

*23020049 East Berlin RECHENTECHNIK DATENVERARBEITUNG in GermanNo 2 1989 p 2*

[Text] In the GDR, the field of microelectronics is the fastest-growing branch of the national economy. The branch currently employs more than 120,000 employees. Since 1980, annual domestic production of semiconductor components has increased in value to over M 2.9 billion. The GDR is one of a small number of countries which exercises integrated control over the development, production and application of microelectronics, including critical raw materials. At present, domestic stocks cover around 80 percent of the demand for microelectronic components. Around 1500 basic component types, from both GDR and other CEMA production, are currently in use. An annual increase of over 26 percent in domestic stocks of active semiconductor components, particularly integrated processor and memory circuits, is envisioned by 1990.

More than a year ago, the national economy of the GDR went over to the use of domestically-produced 256 Kbit chips, still the most widely used throughout the world. A 1 Mbit memory circuit from the Carl Zeiss Combine in Jena can replace many tens of thousands of transistors, diodes, capacitors and resistors. Such a circuit can store up to 35 single-spaced typewritten pages of information.

In the GDR, over M 14 billion have already been allocated for the development of microelectronics. In the current Five-Year-Plan, a new semiconductor plant is to go into operation every year.

# TELECOMMUNICATIONS R&D

## GDR Applying New Approach to Broadband ISDN

*23020045 East Berlin NACHRICHTENTECHNIK-ELEKTRONIK in German No 1, 1989 pp 3-4*

[Article by P.R. Gerke of Siemens AG, Munich: Asynchronous Transfer Mode—A New Direction Towards Broadband ISDN"]

[Text]

### 1. Requirements of a Broadband ISDN

Even though the 64-kbit/s ISDN is in the introductory phase, there is already a worldwide need—not a frequent one, but in general all the more urgent—for even more broadband digital networks. Originally, the emphasis was on applications in moving image communication, while later on greater significance was attached to accessing private networks and data communication with high bit rates. Thus, bit rates above 64 kbit/s are being recommended and/or discussed in the CCITT; these rates currently range from H0 (384 kbit/s) to H4 (approximately 140 Mbit/s) (1). Figure 1 shows a typical application for high bit rates in the public network:

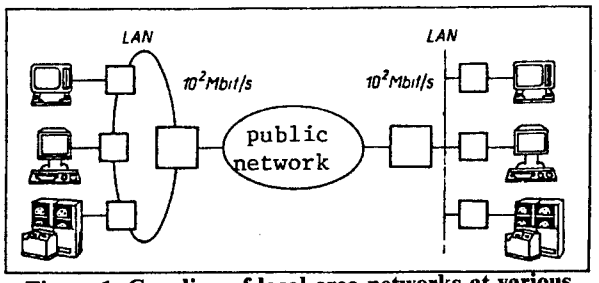


**Figure 1. Coupling of local area networks at various locations**

Two local area networks (LANs) in different sites within a major city are interconnected by way of a "public network."

What are the demands that will be placed on such a network?

Before answering this question, another factor is considered:

With the 64-kbit/s ISDN, one generally assumes that services with lower bit rates will fully tie up a 64-kbit/s channel. If one wanted to proceed similarly in the broadband network, a 2-Mbit/s service would have to be accommodated in a 140-Mbit/s channel. Because of the significantly higher cost associated with this, it makes sense to set up a separate 2-Mbit/s channel. A corresponding situation is true for other bit rates. In this way, several bit rate-specific broadband networks emerge.

Ultimately, a subscriber will not want to always communicate with the highest bit rate available to him, but rather will settle for a lower bit rate where there is less demand, on a case-by-case basis. Correspondingly, he would also like to occupy and pay for less capacity in the network to which he is connected (bit rate on demand). The following requirements can be derived from these application examples:

A future broadband ISDN should not be optimized solely for moving image communication; rather, it should also

1. economically handle packet-oriented data communication, from LANs, for example,
2. integrate the various bit rates in one network,
3. give the subscriber (largely) free choice over bit rate for every communication transaction.

### The STM and ATM Network Principles

Networks that transport information in the "synchronous transfer mode" (STM) are already common in the form of line-switching networks. In the 64-kbit/s digital network, the characteristic feature is (Figure 2a):

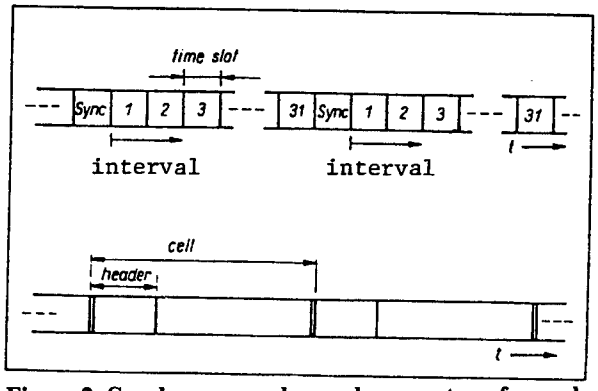


**Figure 2. Synchronous and asynchronous transfer mode**

For the duration of the connection, the subscriber is alloted certain time slots in the transmission and switching system. The connection is clearly determined by the time interval between the respective time slot and a synchronization signal (sync). The time slots are made available to the subscriber regardless of whether they are occupied by information. The line-switching networks are optimized for a particular channel bit rate, the ISDN for 64 kbit/s, for example. Because of these characteristics, they are less suitable for satisfying the requirements in question.

In contrast, information in networks based on the "asynchronous transfer mode" (ATM) is transported in "cells" of a constant length, which (instead of the fixed "interval" in Figure 2a) feature a "header" containing pointers for the relevant connection (Figure 2b). ATM networks are related to packet-switching networks; the previous designation was "fast packet-switching." Different bit rates can be implemented by transmitting cells across the same network at successively varying speeds. The requirements noted above can be satisfied, and the packet orientation is dealt with in the next section.

Cell length and header length have yet to be definitively stipulated by the competent standardization bodies. At present, the primary focus is on cell lengths of 32 or 64 and header lengths of 3 to 4 octets (2).

### Switching Network for ATM

In line switching, central intelligence can be used for seeking a path while establishing a connection, since path-seeking time is negligibly small compared to the connection length. Figure 3b depicts this for a three-stage switching network. Otherwise, the setup is an ATM exchange. There, the "connection length" is determined for all intents and purposes by the throughput time of each cell; e.g., in a 2-Mbit/s flow only 125 µs for 32 octets. If—which will be necessary in broadband networks—many millions of cells must be switched through each second, central path-seeking processes are ruled out. Instead, each individual cell must be channelled through the switching network using "local path- seeking

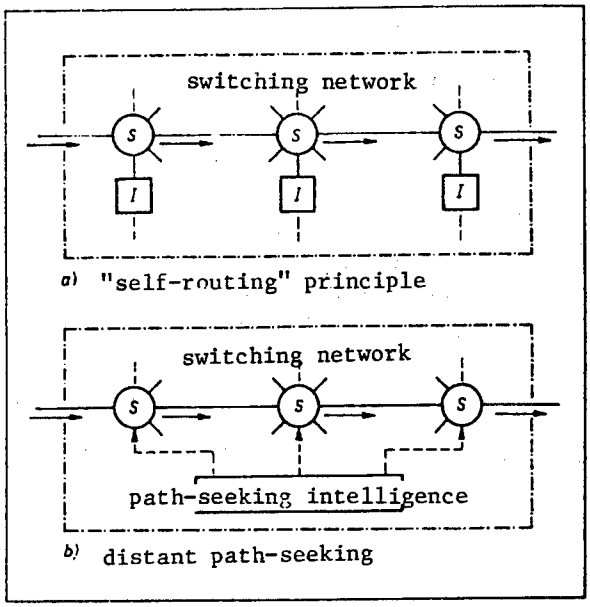


**Figure 3. Path-seeking process**

intelligence" because of the information contained in its header. The intelligence here is allocated to the individual contact elements of the switching network, as has in fact been the case in the 100-year-old "direct dialing systems." Today, however, the term used is "self-routing" switching networks!

There is an extremely wide range of ATM switching network variations, so that it is not possible to go into the various principles here. Let us select a relatively interesting variation, without committing ourselves to any sort of statement concerning its effectiveness. The principle is depicted in Figure 4. So-called beta elements are used as contact elements (Figure 4b). A beta element is nothing more than a switching matrix with two inputs and two outputs, but which has only two switching states: "parallel" or "cross-over" connecting. Thus, only one bit is needed to control the element. As usual, these switching matrices can be used to create multi-layered switching networks, with the potential for several dozens of layers.

Two issues must be resolved:
1. A simple path-seeking algorithm for local intelligence must be found;
2. Internal blocking in the switching network must be avoided.

For purposes of explanation, a small, three-stage switching network, often called an omega or banyan network, is shown in Figure 4a (3).

On the left, the cells are offered that have a special header for the path search. The address of the desired output is now processed according to stage and location,

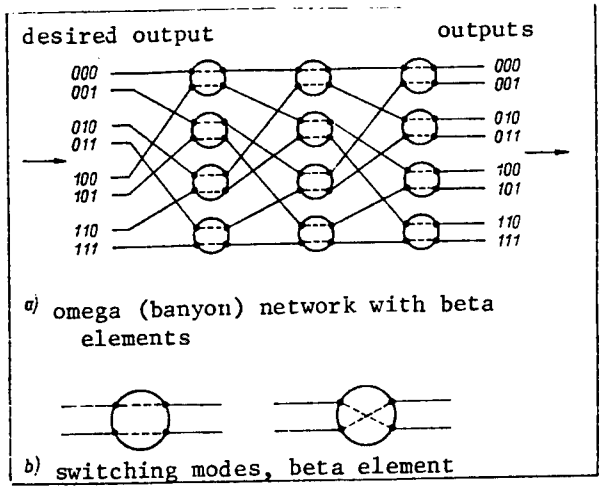


**Figure 4. Excerpt from the "Starlite" design**

and each beta element has to evaluate only one bit of the address. If the bit has the value "zero," the cell is conducted along the upper path, otherwise along the lower path.

Internal blocking can occur if two cells at the inputs of a beta element have to be conducted along the same output. In order to avoid this, cells must be sorted via beta element switching networks connected in series according to the sequence of the desired outputs. Figure 4a shows only the effect of such a sorting network with the outputs of the existing ATM cells indicated on the left. AT&T has proposed a rather complicated switching network based on this fundamental principle, in the form of its Starlite plan (4).

Naturally, external blocking—whereby various cells simultaneously activate the same output—can be controlled only by buffering the competing cells. The type and position of this buffer memory (at the input, in the middle or at the output of the switching network) is similarly characteristic and typical of the various switching network designs. Unfortunately, it is not possible here to discuss this interesting topic further.

In general, it can be said that using ATM switching networks for broadband communication will result in very high demands on the circuitry and design technology. For the distant future, it can be seen that such switching networks will then have to have a throughput in the order of magnitude of 10 to 100 Gbit/s.

## 4. Introductory Strategies for ATM Networks

There is a great deal of evidence to suggest that the ATM principle will lead to a universal network for all services in the long run. However, there is a long and difficult road ahead in pursuit of that goal, conditioned on the one hand by the handicaps of existing networks and on the other hand by the need for the greatest possible economic efficiency in introducing ATM. In principle, a distinction can be made between three means of introduction:

- One begins at the outset with the "universal network" formulation for all subscribers and all services
- One initially limits oneself to all the services in the business realm
- One initiates for the time being only broadband services for which there is no existing network

The necessary transition and adjustments for working with existing networks and services play a major role in deciding on a means of introduction. We are unable to further discuss the generally very difficult problems associated with this at this time.

## 5. A Speculative Look to the Future

Is it possible that in 50 or more years, sophisticated broadband communication will be as widespread, in terms of users, as narrow-band communication is today? Naturally, there will continue to be a great deal of narrow-band communication, since the subscriber will chose the bit rate that he needs, based on the principle of "bit rate on demand." In (5), an assessment is attempted under certain marginal conditions, excerpts of which are reproduced here. If 50 percent of communication continues to be telephone and only five percent is high-quality videophone (here assumed to be at 35 Mbit/s), then only 1.3 percent of the network capacity will be occupied by telephone communication, compared to 74 percent by videophone. (The rest is divided among other services.) If one looks at erlang rates for mixed communication, the result is 4.75 Mbit/s per erlang of network load. Thus, an ATM exchange for 5,000 erlang of mixed communication would have to permit a throughput rate of around 25 Gbit/s. Naturally, this can only be a rough estimate, and it is also very dependent on marginal conditions.

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## Status, Prospects of Czechoslovak Digital Switching System Examined

*24020016 Prague SDELOVACI TECHNIKA in Czech No 12, 1988 pp 441-443*

[Article by Engr Emanuel Prager, CSc: Status and Prospects of the Czechoslovak JSPST-N Digital Switching System"]

[Text] The world trend in switching technology is clearly toward digital switching systems and their further applications in integrated services digital networks (ISDN's). The Tesla telecom subsidiaries began in 1983 the development of a digital switching system, designated the JSPST-N [Unified Switching System-Digital]. This work tied in with the CEMA countries' unfolding cooperation on developing, within the framework of a comprehensive program, an entire family of JSPTS switching systems.

Here by digital switching system we mean a system that interconnects transparent digital channels which can be used for either speech or data transmission, at a rate of 64 kbps. Systems operating on this principle usually employ PCM, and they use modern microelectronic components to implement most exchange functions (analog-to-digital conversion, switching network, microprocessor control, signaling, etc.).

In its first phase, the JSPST-N digital switching system is designed for use in main central office and municipal networks, and in private branch exchanges. The digital switching system's capacity and structure (its maximum capacity is between 8,000 and 10,000 lines served, depending on the average traffic load) make it suitable for exchanges of various size, ranging from about 500 lines to the aforementioned maximum capacity; and in the public network, for main, satellite and tandem offices, suboffices, and concentrators.

### JSPST-N Switching System's Structure

As evident from the block diagram in Fig. 1, the JSPST-N is a switching system with completely decentralized control. The system comprises separate modules, each with its individual control unit (RJ) that ensures the module's autonomous operation. The modules may be divided into two classes:

- Link modules, for interfacing with neighboring networks, and
- Exchange modules, for circuit switching and exchange functions.

The modules are connected to the central switching network [CSP] through a (32-channel) PCM line link and a standard interface conforming to recommendations CCITT G 703.

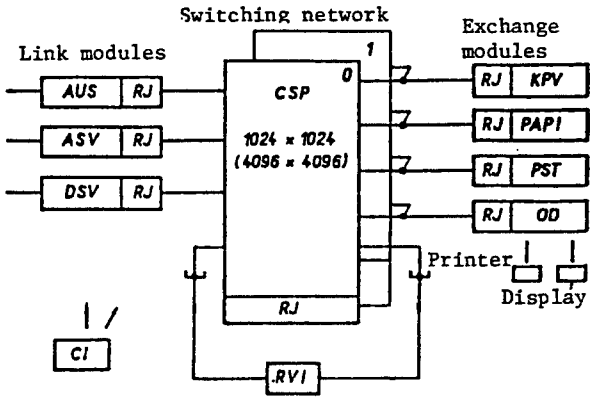



**Figure 1. Block diagram of the JSPST-N switching system.**

| | |
|---|---|
| ASV | =Analog trunk link module |
| AUS | =Analog line link module |
| CI | =Clock and signal tone generator module |
| CSP | =Central switching network |
| DSV | =Digital trunk link module |
| KPV | =Code receiver and sender module |
| OD | =Service and supervision module, for communication between maintenance and the exchange |
| PAPI | =Module for recording the exchange's administrative and operating information |
| PST | =Line and plant diagnostics module |
| RJ | =Control unit |
| RVI | =Information exchange control module |

The main link modules are:

- The AUS analog line link module for connecting 128 lines, through 30 speech channels, to the switching network (at an average traffic load of 0.15 erlang per line served). The system may also employ 64- and 256-line variants of this module, at an average traffic load of 0.3 and 0.08 erlang/line respectively; and
- The ASV analog trunk link module for connecting a group of 30 trunks, through 30 speech channels, to the switching network. The trunks may be of the two- or four-wire type, and the employed signaling techniques may vary.

The mentioned two types of link modules serve to adapt the existing analog local networks and trunks to the JSPST-N system, which employs digital switching. In their interface circuits, therefore, both these modules have individual analog-to-digital converters, one for each line.

For future digital networks, the DSV digital trunk link module has been developed to connect a 32/30-channel PCM trunk link to the exchange's switching network. For ISDN's, a digital line link module will be developed to connect data terminals attached to two-wire digital subscriber lines; i.e., to implement (narrow-band) ISDN services.

In the basic central office configuration, the switching network module has 1024 x 1024 channels; i.e., 32 PCM line links. An array of 512 x 512 channels is available for smaller offices. And expansion to 2048 and 4096 channels respectively is also possible for a main central office of maximum configuration and a tandem office. The switching network, through which all calls and the internal signaling of the office pass, is always duplicated for reasons of reliability.

The principal exchange modules are:

- The RVI information exchange control module;
- The KPV code receiver and sender module;
- The PAPI module for recording the exchange's administrative and operating information;
- The OD service and supervision module, for communication between maintenance and the exchange;
- The PST line and plant diagnostics module; and
- The CI clock and signal tone generator module.

The modules are connected to the switching network through a standard interface. This permits the office's expansion and the addition of new modules in future, without interfering with the existing system.

Each module has its own decentralized individual microprocessor control unit (RJ) that processes all the functions of the module. When information is needed from another module to establish a call, or when completion of establishing the call has to be transferred to another module, for instance, then over channel 16 (which is reserved for signaling) the control unit sends a message with the called module's address. This message passes through the switching network and the information exchange control module, to the called module. With the help of such messages, which are transmitted in both directions in the packet-switching mode at a rate of 64 kbps, the various modules are able to communicate with one another, in all phases of establishing, maintaining and clearing a call.

The control units (RJ's) of the individual modules are 8-bit microcomputers with 8080 microprocessors. Each control unit is a multicomputer that comprises a master control microcomputer, and a preprocessing and communication computer. The principle of memory paging is employed to increase memory capacity for storing the programs and data in these microcomputers. A changeover to 16-bit control microcomputers, with 8086 microprocessors, is expected in future.

The software written for the control units in PL/M language varies in length by modules, from a few to hundreds of kilobyetes (about 120 kB for the line link module's control unit, for instance). The total volume of software available at present is over 500 kB and is expected to grow further as the range of functions is broadened and the proportion of diagnostic programs is increased.

The software also includes diagnostic programs that are intended to quickly identify faults and, if necessary, to initiate more detailed further testing of the entire system or of its parts. The diagnostic programs are being updated gradually as the system's development proceeds. They will be completed only after the trial operation of the telecom networks. Diagnostic programs are now available for about 70 percent of the system.

**JSPST-N System's Microelectronic Circuitry**

A characteristic feature of the digital switching system is the design of the subscriber line interface circuit (i.e., the circuitry of the subscriber line's termination at the local office). This interface circuit must provide not only access to the communication circuits as well as all the functions of present-day switching systems (power supply for the subscriber loop, ringing, etc.), but also A/D and D/A conversion, together with the associated hybrid junction for converting the two-wire communication channel into a four-wire one. All these functions usually are lumped together under the acronym BORSCHT circuit, and the various firms have complete sets of integrated circuits to implement these functions. Sometimes the acronym SLIC is used for subscriber line interface circuit.

The Tesla Communications Research Institute, and the Tesla Roznov and Tesla Piestany subsidiaries have developed the circuits used in the JSPST-N system's development. These circuits are:

- A SLIC circuit for the (low-frequency) subscriber line interface;
- A filter to limit the speech band in the go direction and recover the speech signal in the return direction;
- A codec for coding and decoding the signal (i.d., for analog-to-digital conversion); and
- A controller for the allocation of time slots.

In addition to these basic circuits, there are also several auxiliary circuits of more simple design.

All the mentioned circuits are being readied for production within the Tesla Electronic Circuits and Components Group and will be produced after 1989. Because of the employed technology, a voltage higher than 56 V cannot be guaranteed for the SLIC circuit. Which means that a voltage higher than 48 V (for example, a ringing current ranging from 150 to 200 V) must be supplied to the subscriber's line through the contacts of a miniature relay (dual in-line design).

**Present Status of Development**

Development of the JSPST-N is now in the prototype stage. Two prototypes have been built, each with 500 lines and extensions respectively, one for a public local central office, the other for a private branch exchange. Prototype tests were held in 1988. After their evaluation, the system will be readied for pilot production.

Table 1 shows the principal economic parameters achieved in the course of development. In comparison with the foreign system that represent the peak of world technology in this field today (the E-10B, ITT 12 and AXE 10, for instance), the JSPST-N falls short of the world level in some of its parameters (in total plant area or power consumption, for example).

**Table 1. Comparison of the JSPTS-N System's Principal Parameters With Selected Foreign Systems**

| Systems | S-12 Alcatel | E-10B Alcatel | AXE 10 Ericsson | JSPST-N Tesla |
|---|---|---|---|---|
| Switching | Digital | Digital | Digital | Digital |
| Control | Decentralized | Centralized, partially decentralized | Centralized, partially decentralized | Centralized |
| Power consumption | <2 W/line | <2 W/line | <2 W/line | >2 W/line |
| Packing density, lines/$m^2$ | 258 | 165 | 200 | 143 |
| Radiated power | 500 W/$m^2$ | 230 W/$m^2$ | 320 W/$m^2$ | 254 W/$m^2$ |
| Lines/frame | 1,000 | 1,000 | 1,000 | 750 |
| Subscriber loop's range at 48 V | 1,900 Ω | 1,900 Ω | 2,000 Ω | 1,800 Ω |
| ISDN services | In trial operation | In trial operation | In trial operation | To be added |
| CCITT No 7 signaling system | Included | Included | Included | To be added |
| Maximum capacity of local office | 100,000 lines | 60,000 lines | 200,000 lines | 10,000 lines |

The mentioned relative lag is due to the characteristics and inadequate assortment of the electronic circuits produced in Czechoslovakia.

Functionally the system meets all the requirements of the present networks, and also a number of new requirements that correspond to the world trend in this field. Although not all added functions have been prototype-tested so far, they will be gradually incorporated into the system in the further stages of development.

### Further Prospects of JSPST-N System's Development

In its present developmental stage, the JSPST-N system is being readied for installation in existing networks where it will be able to replace advantageously the present electromechanical systems, within the limits of its capacity. When installing the system in a network, however, certain principles have to be observed that follow from the system's principles of operation.

In terms of transmission, the digital switching system operating in an analog environment (analog network) must be regarded as a four-wire section connected to an existing, mostly two-wire, speech transmission path. From which there follow certain limitations from the viewpoint of attenuation and the transmission path's possible frequency swing. Therefore these digital systems cannot be used randomly in just any part of a network. Instead, certain principles have to be formulated for their economical and functional use. Here we must realize that the use of digital switching systems in a network is actually a transitional stage leading to the telecom network's transformation into a fully digital network. In the digital network there will be analog-to-digital and then digital-to-analog conversion of the signal only at the network's entry and exit points. In all other parts of the digital network the switching and transmission paths will carry only a digital signal, without its conversion to an analog one.

The most advantageous solution in this respect appears to be the creation of so-called overlapping networks: i.e., of a digital network that parallels the existing analog network, but has a minimum number of common junction points with it.

As an example, Figure 2 shows the principle of installing digital switching systems to expand a main central office network built with PK and P-51 electromechanical switching systems. For the purpose of installing digital switching systems and reducing the number of common junction points with the analog network, it seems best to add a parallel digital section to the main central office. The newly built digital peripheral offices are connected to the digital section by PCM trunks. An autonomous digital network emerges that is connected to the existing analog network only at the level of the main central office. With the gradual conversion of the analog network to digital switching, the entire network eventually becomes fully digital. Other types of networks—municipal and toll networks—can be converted to digital switching in the same manner.

The creation of partially or completely digital networks will pave the way for using them to provide ISDN services. In implementing the ISDN's it will be possible to use the JSPST-N digital switching system practically without change in its concept and design, but with the understanding that certain function modules stemming from the ISDN concept and requirements will have to be added. CCITT recommendations already specify the functions, interfaces and protocols for these new modules that will combine in a single network primarily the

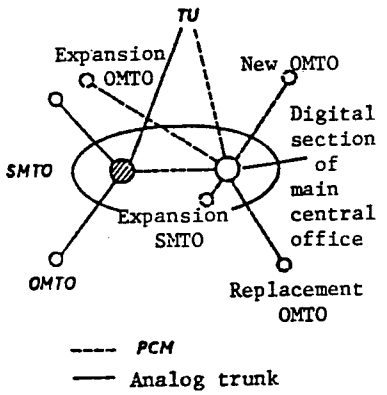



**Figure 2. Gradual conversion of main central office network to digital switching systems.**

OMTO =Peripheral office area
SMTO =Main central office area
TU =Toll exchange

so-called narrow-band ISDN services (data transmission, teletext, facsimile, and slow-scan video for picturephones), together with speech transmission. This provides the basis for creating a worldwide ISDN system, and for standardizing the designs of the most diverse types of terminals for such networks. Future expansion of the ISDN's will add so-called broad-band services for transmitting video signals of TV quality, stereo programs for distribution, for teleconferencing, etc.

The addition of ISDN services to the digital networks will require also a new signaling system, one that will be able to operate for all types of services on the same telecom network. The CCITT has already recommended for this purpose its so-called CCITT No 7 signaling system that operates on transparent digital channels at a rate of 64 kbps. All types of switching systems within the national and worldwide networks will be using this method of signaling in future. This will not only permit economical implementation of an integrated network, but will also eliminate the present problems associated with the use of very diverse, and often very complicated, types of signaling in individual parts of the national networks and of the international ones as well. The new signaling system's structure is based on the layered model of the OSI. This permits unifying the associated signaling channels, and confining the (so-called user) differences in signaling to separate classes of equipment employed in these signaling systems.

To add the No 7 signaling system to the JSPST-N switching system, a new module will have to be developed that concentrates the return signaling channels (transmitted at a rate of 64 kbps), analyzes the essentially packet-switched signals and directs them to the switching system's control circuits.

In accordance with the CCITT recommendations, normal two-wire lines will be used to connect terminals for narrow-band ISDN services (facsimile, teletext, intelligent phones, data transmission, picturephones, etc.) to the switching system. Four-wire transmission without repeaters is possible over such lines to distances of several kilometers, at rates of the order of 100 kbps.

Transmission will employ the principle of echo suppression, which will make four-wire transmission at these rates feasible over subscriber lines. Transmission rates of 144 kbps will be used in both directions. That means a 2B + D channel design, where B is one of two transmission channels with a rate of 64 kbps each, and D is the data channel with a rate of 16 kbps. The B channels can be used for speech transmission, and also for data transmission to and from data terminals. The D channel is intended for signaling, packet switching, and perhaps for telemetry and emergency signaling.

The 2B + D tranmission mode is the basic subscriber line, intended for connecting to the exchange various terminal configurations, up to eight terminals per subscriber line. In addition to the basic subscriber line, there is also a standard primary access, designated as 30B + D. This is actually a 30-channel PCM link for connecting larger groups of subscribers, concentrators, PBX's, etc.

To interface terminal equipment with the subscriber line, individual interfaces—designated as U, S, R and T interfaces—have been standardized. We expect to use a so-called network termination (NT) on the subscriber-line side of these interfaces. The network termination will serve as an adapter for attaching the terminals and supplying them with power.

Suitable interface circuits will have to be developed for the switching system to make feasible the terminals' connection to the exchange, through the adapter and the service line. The function of these circuits will be to analyze, in addition to the electrical parameters, also the signaling in channel D and to direct this information (respectively the packet-switched data) to the exchange's control circuits. Another task of the interface circuits will be to ensure the transmission and recovery of signals in the associated B channels, and to send the signals to the switching network, through the standard interface.

Naturally, the addition of broad-band services in future will require further modifications of the system. Thus, besides adapting the subscriber line interface circuit, a broad-band switching network will have to be created, output circuits will have to be designed for input into the video transmission networks, etc. The implementation of these parts, however, will come much later.

The addition of the mentioned new parts to the JSPST-N system will not only mean further partial improvements, but will also represent a basic innovative step toward creating a system suitable for future ISDN's. The realization of this transition (i.e., of the mentioned modules' development) will depend in part on the further course

of standardization efforts within the CCITT and on the plans of the Czechoslovak telecom authorities regarding the gradual introduction of ISDN's; and in part on the possibilities for developing, and introducing the production of, special LSI circuits for the economical implementation of such services. The world's leading telecom firms have been working on perfecting this field. There already exist several types of special integrated circuits for individual subscriber line interfaces, and further rapid progress in this area can be expected worldwide.

Digital switching systems offer new prospects for creating modern telephone networks that will be used to transmit various kinds of information. The described JSPST-N switching system will be merely one of the building blocks in these new networks. Its use, together with other systems that will emerge from international cooperation within CEMA, or in combination with imported systems, will make a qualitative jump possible in the construction and expansion of telecom networks.

## Hungary's Bloc Telephoto, Press Network Discussed

*25020024 Budapest*
*COMPUTERWORLD/SZAMITASTECHNIKA*
*in Hungarian 2 Nov 88 p 6*

[Article by Huba Bruckner: The Pictures of the Future"]

[Text] Between the Hungarian Telegraph Bureau [MTA] and its more than 70 partners, news exchange is continuous over 24 hours of the day. It is a global phenomenon that the traffic of news agencies, the amount of material received and transmitted doubles every 6 to 7 years. The growth in traffic requires the continuous renewal of communication methods and equipment.

In the early seventies the MTA initiated a modernization of the communication network among the socialist countries and took it upon itself to develop the necessary technical installations. As a result of this effort, a multiplex installation for the multi-channel transmission of news and pictures was created of which more than two hundred were installed in Europe and in countries on other continents.

In the international telephoto network of socialist countries, the products of the developmental effort carried out in the seventies under the direction of Gabor Budai—and also honored with the State Price—are still being used today.

After the establishment of the international network, and based on the favorable experiences, the domestic press and news network was built during the second half of the seventies. The solution, based on a basically analogous technique, has brought about a qualitative change in the information supply of the megyes' press.

### Praise of the Digital

Sent via the global electronic picture transmission network, the pictures must arrive nearly simultaneously with the events at practically any point of the globe. In addition to the demand for speed, the demand for quantity also increased because more pictures are demanded not only by the print media but television also appeared as a new consumer. The transmission, editing and storage of traditional pictures on paper is becoming increasingly difficult in the age of the electronic press not even mentioning the rapid increase in costs.

Demands can be satisfied only by applying the digital technique. After all, photos described using digital signs can be processed, stored, electronically enlarged or reduced in size, retouched and provided with captions by means of a computer. At the reception site they can again be stored and a paper print will have to be made (if at all) only of those which will be actually needed in the publications.

Because of its geographic location and technical preparedness, the MTI is taking on an important role in the transmission of the news and picture material of global agencies. The introduction of digital technology in the telephoto service was justified by increased domestic demands, technological changes accompanying the electronization of editorial offices and also by the international connections.

In our country, the new technique was first applied for international picture transfer. Meanwhile, it became obvious that the domestic facsimile network is increasingly falling behind the requirements. The problem is further aggravated by the fact that the telephoto equipment purchased earlier is already unreliable and rather costly to run.

The situation is ripe for modernization of the network. The more so because the change in technology will thus coincide with the process of electronization of the press.

### Large-Scale Developments

Miklos Toldy, head of the Main Ofice of Development and Investment of the MTI, related that the introduction of digital facsimile transmission is considered part of a comprehensive developmental effort.

The construction in progress on the Nap Mountain in Buda can be seen from far away. The new service wing under construction provides a neat cover for the rather out of place "socialist-realist" building nearby. The microwave and satellite-receiving antennae will be placed on the top of the all-glass building.

The OMFB [National Technical Development Committee] is also contributing funds for the establishment of the national telephoto network. Its center will be in the MTI building where the pictures will arrive from the foreign

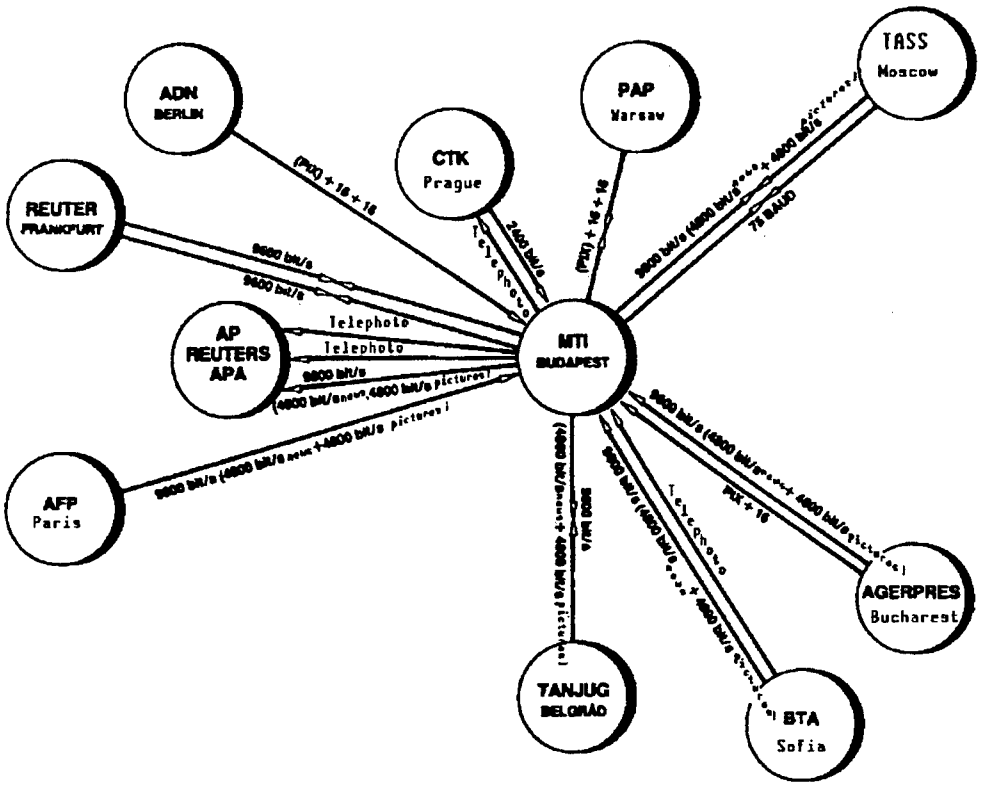



**Figure 1. The international news agency connections of the MTI.**

agencies and the MTI editorial offices in the provinces. The rate of transmission is 9600 or 14,00 bit/s, customary on international lines, but 16,800 bit/s will also become possible soon. Processing of the photos and the preparation of Hungarian language captions will be done at the picture-editing terminals and the pictures will be stored in the linked computer. The digital technique enables the amassing of a considerable amount of information but even though, capacities on the order of megabites are needed for the storage of individual pictures.

The edited pictures are then forwarded to the editorial offices of the papers, compiled according to demand. Here, equipment of lesser capacity is also quite sufficient because only a few dozen pictures have to be stored and recalled each day. Therefore, while a disk storage capacity handling system, built around a mini computer with several hundred megabites, must be located in the center, equipment based on a personal computer will also suffice in the editorial offices.

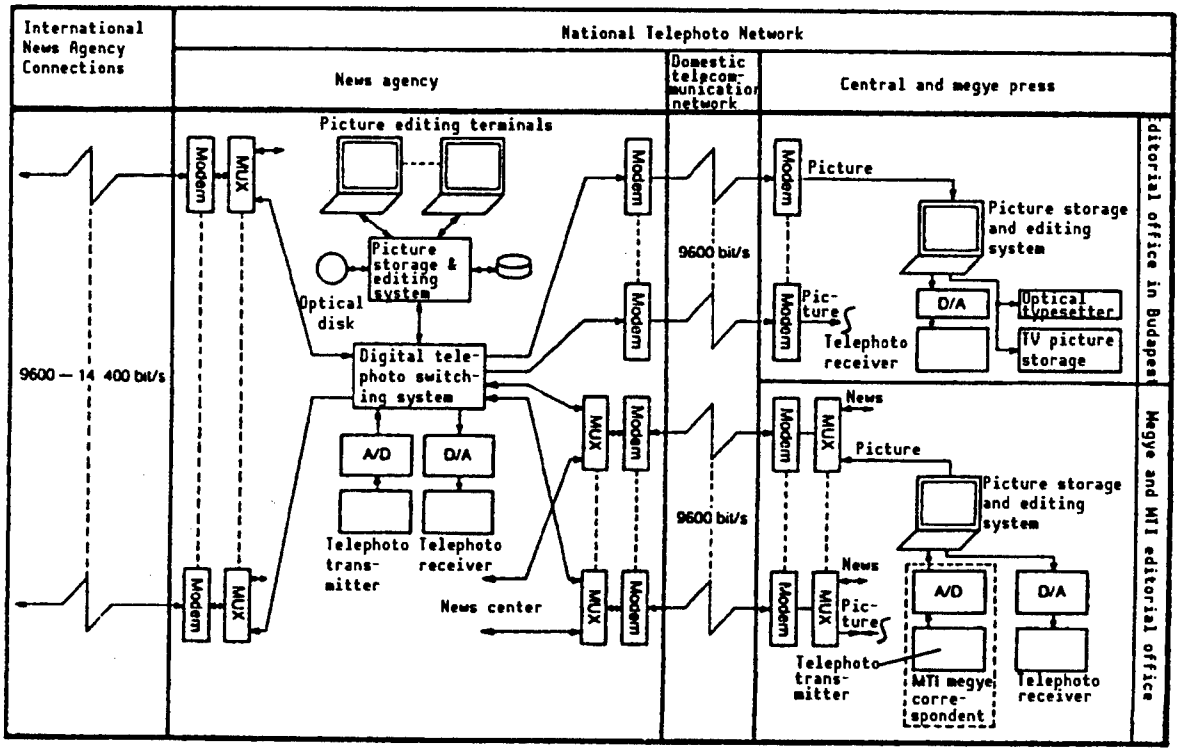
The essence of the entire telephoto network is the digital switching system which can be likened to an intelligent, special purpose telephone center. It controls the quality of the incoming signal, corrects it within a given range, and forwards the data flow in the appropriate user directions. With the center, transmission paths can be built at will including the sending of the same signal to several "addresses" simultaneously. The latter must be used, for example, when the most important picture material is being sent simultaneously to several editorial offices.

### On the Way

The essence of the telephoto system is already in operation, moreover, its expansion and the development of new functions go on continuously. In addition to picture processing, retouching and editing capabilities, the simultaneous production of as many as 16 pictures will be possible in the future, aiding rapid oversight and editing. Experience shows that electronic picture storage and recall represent considerable savings because no longer are there paper prints made automatically from the masses of photos received from the news agencies. This will be necessary only for photos selected by the picture editors in cases when some editorial office is not yet prepared to receive the electronically transmitted pictures.

The electronic storage of pictures makes it possible to recall them using data base techniques, that is, the needed pictures can be selected on the basis of a simultaneous fulfillment of several conditions. It is characteristic of the digital technique that the quality of the pictures does not deteriorate in the course of the various steps of manipulation, which would be unthinkable with the analogue technique.

Figure 2. Systems Diagram of the National Telephoto Network.




When the network is fully completed, the picture material will be forwarded electronically to the central press and the megye editorial offices just as the photos will also arrive in the form of data signals from the megye seats to the MTI. According to plans, megye systems, which can be built around personal computers of lesser capacity, will be built with domestically developed components.

The experimental central switchboard for the digital telephoto system has been completed and is already in everyday use. The developmental engineers of MTI are already working on the final version. Outstanding work is being done by the enthusiastic team; this is reflected also by the fact that Reuter, one of the world's largest news agencies, also indicated that it will purchase the center developed in Hungary.

### Optical Archive

In addition to the introduction of modern cameras that take pictures on magnetic disks and electronic picture transmission, the modernization of picture storage also fits into the broad developmental plans of the MTI.

The news agency owns perhaps the largest picture archive of the country. Today, the mass of pictures numbering several millions is kept on microfilm. Probably not for long. It is their firm intention to put everything possible, primarily telephoto pictures, into optical storage in the future. Of course such a significant change in technology is only possible after a thorough preparation and in the possession of adequate money. If nothing else, the lack of money will certainly delay the change over. This hurts only partly in the age of the rapid development of optical storage because of the appearance of ever improved systems. However, with passing time, the stock to be stored is further increased and, therefore, the change-over cannot be delayed much longer.

Fortunately, there is already ample experience with applications because many of the world's large news bureaus and publishers are storing their picture material on gigabite disks sparkling in the colors of the rainbow.

## Yugoslavia: SI-2000 Telephone Gear Described

*24020017 Prague SDELOVACI TECHNIKA in Czech No 1, 1989 pp 25-26*

[Article by Eng Jaroslav Slunecko: "Telephone Centrals of the SI-2000 System"]

[Text] At the Iskra Telematika Enterprise in Slovenia where telephone centrals have been in production since 1950, development of a fully electronic SI-2000 system was begun in 1980; the system, together with the 1240

system, was to comprise the production program for centrals through the year 2000. There is an entire series of Iskra enterprises and each one has its own special program. From the telecommunications standpoint, the enterprise which produces transmission equipment with a frequency division for 12, 24, ..., 10,800 channels and transmission system with a time division in the TDM-PCM mode for 30, 120, and 480 channels is the one which is important. Anonther Iskra enterprise is producing optical cables with attenuation better than 3 dB/km for $\lambda$ = 850 nm with a band width of 700 MHz and cables with attenuation better than 1 dB/km for $\lambda$ = 1,300 nm with a band width of 1 GHz. Regeneration of signals transmitted by light conductors is, thus, usable for 12 to 15 km in the case of $\lambda$ = 850 nm and for 26 to 32 km for $\lambda$ = 1,300 nm. The Iskra Delta Computers Enterprise is also participating in the production of telephone centrals.

The first item introduced into production was the private branch exchange Model SI-2000-020. A considerable quantity of these exchanges is already functioning successfully, both in Yugoslavia and also abroad. Furthermore, a new generation of digitalized exchanges of modular design was also developed. The basis for this design is a module which is controlled by a microcomputer. The SI-2000 exchange utilizes PCM digital communications equipment which presents the possibility for utilizing this equipment even in future networks. At the same time, this equipment is compatible with existing exchange systems. The conversion of analog voice signals to digital PCM signals fulfills the recommendations of the CCITT for time-divided multiplex 32-channel equipment. The program controls are divided into individual modules. Each module services a smaller number of subscribers and the exchange as a whole is less sensitive to incidental defects.

The technical aspects of the exchanges utilize the most modern circuitry produced with HCMOS and VLSI technologies. The microcomputer is controlled by a Model M-6802 microprocessor. The memory capacities are 256 x 1 kB—DRAM and 32 kB—EPROM. The conversion of analog signals to digital PCM signals and vice versa is accomplished by a single COMBO jack. Similarly, the receivers of the frequency selector are located in a single jack. By using modern components, the consumption of energy and the requirements for space have been substantially reduced.

Use of the modular design, the basis for which is the functional module which takes care of telephone functions or control functions, makes it possible to use a random configuration for the exchange and to expand it to a maximum of 64 voice modules. The exchanges are designated models SI-2000/xyz, where x gives the region of utilization, y designates the type of central, and z the specific version of the central (currently, z = 4). The significance of the x, y index is given in Table 1.

**The Significance of Interchangeable x, y Values in Designating the Exchange Equipment**

| x | Significance of Model Designation |
|---|---|
| 0 | Private branch exchange |
| 1 | Exchanges for special networks |
| 2 | Public exchanges |
| y | |
| 1 | Exchanges having one subscriber module |
| 2 | Exchanges having several subscriber modules |
| 3 | Exchanges having digital subscriber modules |

**Description of Individual Module Functions**

Each module is controlled by its own microcomputer in its optimalized version. The Model M-6802 microprocessor is able to address only 64 kB of memory. That is why the microcomputer has an electronic switch and can address eight data bank memories. For the time being, some of these are not utilized.

The connection between two participants of the same module is accomplished in the analog mode through the use of the matrix switching field (analog multiplex). The field is created by CMOS matrices and has 32 vertical components. The number of horizontal components is greater, according to the type of exchange, and in accordance with the requirements of operations or of the subscriber. The vertical components are connected to PCM samplers which transmit the signal to the GSM switching module. Subscriber sets are connected to the horizontal components (eight per plate), as well as transmitters and signal receivers, transmitters of private branch exchanges and, possibly, connections to the work station of the operator. In the case of large private branch exchanges, it is advantageous to solve the question of transmitters which support cooperation with existing analog centrals with the aid of ANM analog communications links. Connections with digital exchanges are taken care of by the DNM digital transmission module which has 32 transmission channels.

The GSM switching module handles connections with various subscriber ASM modules, or between a subscriber module and the ANM or DNM transmitter modules and, via these modules, to other exchanges. Communication is accomplished via a time switch. The switching module is the only device through which virtually all connections pass and must, thus, have considerable redundancy. Important components such as, for example, microcomputers, power sources, and pathways along which communication is actually accomplished, are, therefore, duplicated. The PCM code is 8 bits long, the time multiplex has 32 channels, of which 30 are voice channels. A special duplicated IPC reversing

switch exists for purposes of accomplishing communications between the microcomputers of all attached modules. It is possible to attach 64 voice modules and several nonvoice modules to the switching module.

An administrative module with a teletype, a visual display, and a cassette tape unit makes it possible to start the exchange after it is connected or following a disruption (introductory program) and carries out all communications involving the exchange. It executes changes with respect to semipermanent data in the memory of the computer, writes out errors, and provides statistical data regarding the operation of the exchange, etc.; it also includes a built-in modem. Programs and data are entered on a CIPHER 540-S cassette tape unit.

The cassette tape unit is also used by the CHM tariff model. Tariff pulses are first entered into the RAM memory of the subscriber module. In the event of a power failure, this memory has a reserve lithium power source with a life expectancy of 10 years. Later, tariff impulses are reentered into the current memory of the tariff module, and the tariff, together with the number of the calling subscriber is recorded on the cassette tape unit.

The SI-2000 exchange unit facilitates the connection of the Model X-25 switch, according to standards issued by the CCITT for the digital transmission of data packets. The switch can have up to 12 transmitters connected to it, the maximum velocity of transmission is 110 packets per second. Multil'ADs are packet-uniting units with 4 to 16 terminals per transmitter. In Yugoslavia, the JUPAK system corresponds to the PDN (Public Digital Network). The system is compatible with the future ISDN (Integrated Services Digital Network) system for the transmission of data from state and international information centers, for the transmission of texts, diagrams, illustrations, etc. For the time being, the portion having the X-25 is used only exceptionally. A block diagram for the exchange is given in Figure 2 below.

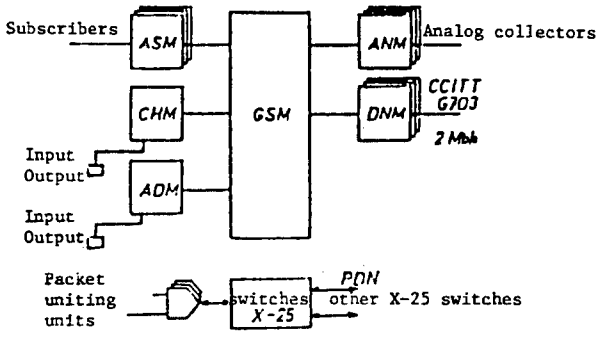



**Figure 2. Block diagram of the SI-2000 central:**

ADM =Administrative module
ANM =Analog circuit module
ASM =Subscriber module
CHM =Tariff module for digital circuits
GSM =Switching module
X-25 =Switch

### Assembly and Maintenance of the SI-2000 System

Assembly of the centrals is simple. The function modules have connectors on their backs into which functionally completed boards can be slid (slide-in units) and the tips of the individual connectors are connected with the rear panel by flat connectors. The individual modules are interconnected with standard cables. The modules of the central office are installed in cabinets measuring 1,900 x 700 x 450 mm. The room for centrals having several modules should be at at least 2,400 mm high, which is the current height of a regular room for living. The floor should have a minimum carrying capacity of 3,000 N/m$^2$. The temperature can range between 5 and 40° C, the relative humidity can range from 30 to 80 percent.

Small centrals having one subscriber module are produced in three sizes, depending on the number of subscribers. They are designated SI-2000/014, /214, or /114 and are housed in two, three, or four subframes. The main subframe houses the microprocessor with the appropriate interface, the multiplex, the subscriber sets, the transmitters, and signal equipment. Additional subframes are peripheral in nature and serve to increase the number of subscribers. The lower subframe holds the rectifier and the 48-V battery which is closed. The 48-V power source is used to provide any additional power for stabilized sources directly in subscriber modules. The central does not have any special climatic requirements and can operate, for example, in the reception office of a hotel or in an office of an enterprise. In the case of terminal centrals where operations are small-scale, it is possible to utilize dual connectors and to raise the number of subscribers up to 480.

The SI-2000/OMC (Operation Maintenance Center) was developed for maintaining and controlling a larger number of centrals from a single center; this device is generally located in the room having the largest central of a specific circuit. This likely also corresponds to the Czechoslovak Model MTO-B, -C, -D centrals. We attach the centrals to teletype units at the central office and any possible errors show up in the OMC printout. An alarm light appears on the cabinet in which the error has occurred, as well as inside on the slide-in unit of the defective module. Following the analysis of the error printout, a maintenance technician is dispatched to the central having a defect and carries with him the necessary slide-in unit. At the OMC, the computer is compatible with the IBM PC-AT. It is used to adjust all cassettes for tariffs to conform to the shape of the listed telephone numbers and the number of impulses during the month at the end of the month. The data are transmitted to the central office where invoices are written. Lower-level OMC units can be connected to higher-level SI-2000/OMC units.

**Programming**

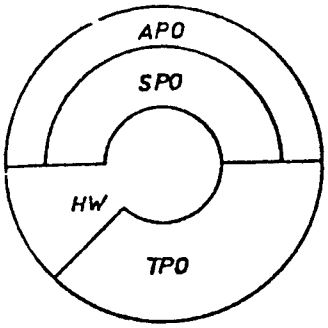



**Figure 4. Depiction of programming:**

APO =Application program
SPO =Operating system
TPO =Diagnostic programs
HW =Instrumentation program

Current connection between two subscribers can be augmented by the addition of other connections and the formation of conference connections involving as many as eight subscribers. The program records the number of subscriber stations participating in the conference call and equalizes the greater signal loss.

The program is divided into three main parts, as can clearly be seen from Figure 4. The operating system (SPO), the application program (APO), and the "on-line" diagnostic programs (TPO). The programs operate cyclically. The programs are activated every 10 ms on the level of an hour pulse. These are mainly programs to register changes in test points, that is to say, the picking up or laying down of the handset, changes in transmitters, etc. (scanning programs). These programs are followed by basic-level programs (base level) where the principal functions for accomplishing or breaking contact take place. On the same level, the "on-line" tests are carried out which control both instrumentation and also programming. Apart from these programs, there are programs for the thorough testing of the computer, of a module, or of the entire central. They are recorded on a magnetic tape and are transcribed into the computer through the use of the administrative module. These tests are conducted during a time when the central is not in operation ("off-line"). They are used to test new centrals, to test centrals following assembly, and possibly even during maintenance operations when a complicated error has shown up.

The central office can fulfill various functions in conjunction with international standards. There are somewhat more than 100 functions and, therefore, I shall list only some of the most significant ones from the standpoint of private branch exchanges. Subscriber functions: change in the direction of the call, the subscriber is waiting for a connection to be made; a subscriber with a higher priority is waiting for a connection to be made; abbreviated dialing; abbreviated dialing in local operations; patching of public connection into the telephone of a "busy" subscriber. Restrictions: restriction of connections involving selected network groups; unauthorized connections; restrictions in local operations; restriction of automatic connections; restrictions for certain call directions; restriction of connections to the public network; "do not disturb"; "not present"; restriction of connections which have been called, etc.

**Conclusion**

The PCM electronic system used in the SI-2000 gear contains solutions for solving centrals from the smallest, having a single ASM module serving several tens or even hundreds of subscribers, through the largest system having 64 voice modules, that is to say, 10,000 subscribers with an appropriate number of transmitters. The centrals use the most modern components and meet all CCITT requirements. The solution is very flexible; a central can easily be expanded, a change in semipermanent data can be used to balance the load in the directions of call and can change the subscriber categories involved. Power consumption is small and requirements for space are minimal. It is possible to control and repair an entire series of centrals from the central SI-2000/OMC unit. After adding an X-25, switch we can operate with packet-uniting units.

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